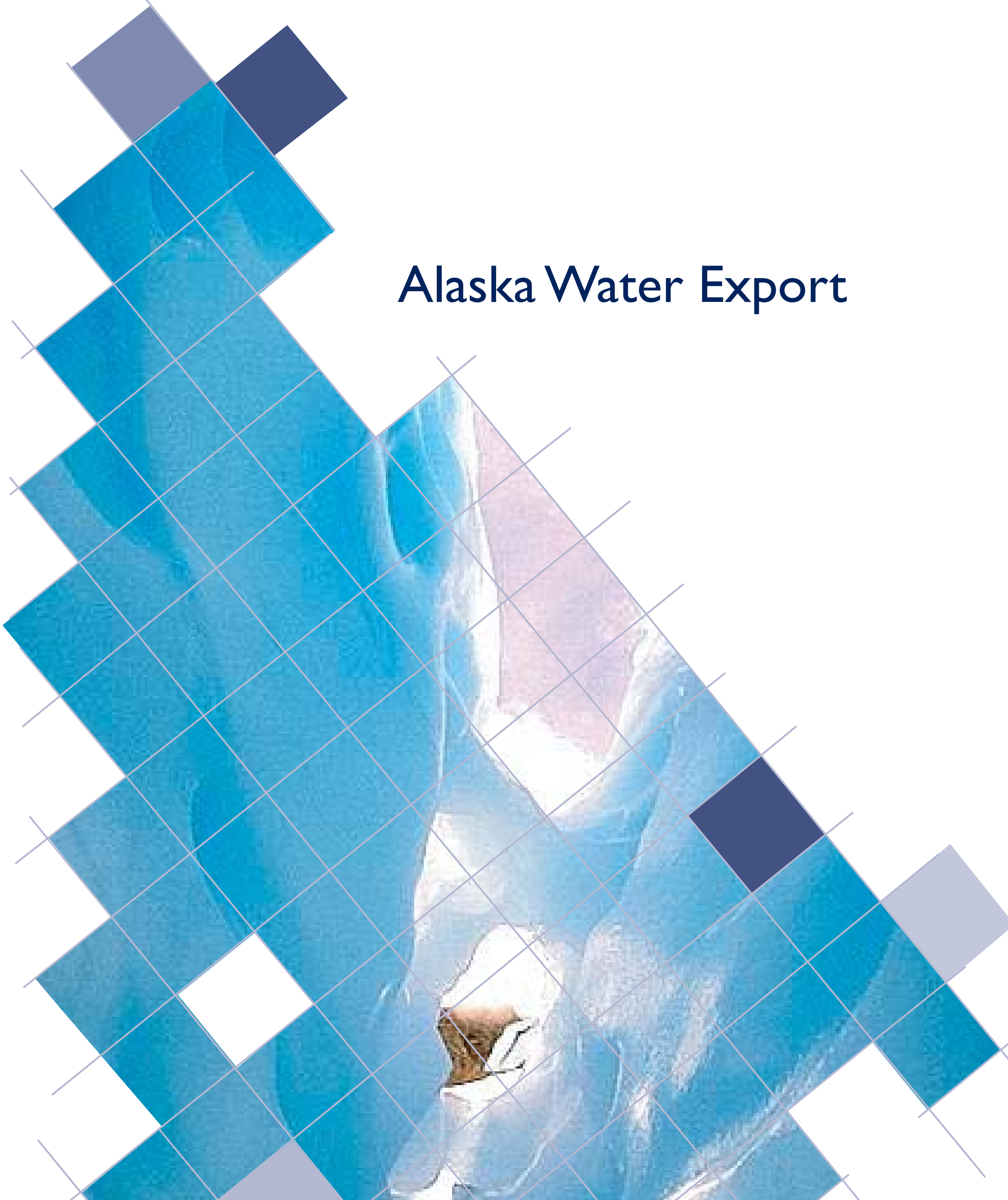
Alaska Water Export



northerneconomics inc.
In association with
Alaska's Best Water ♦ MWH

Prepared for the
Denali Commission
February 2004

Alaska Water Export

Final

Prepared for

Denali Commission

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Prepared by

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Abbreviations

AAC	Alaska Administrative Code
ABW	Alaska's Best Water
AWWU	Anchorage Water and Wastewater Utility
CFR	Code of Federal Regulations
CGMP	Current Good Manufacturing Processes
ED	Electrodialysis
FAO	United Nations Food and Agricultural Organization
FDA	U.S. Food and Drug Administration
GDP	Gross Domestic Product
MED	Multiple-effect Distillation
MFD	Multi-state Flash Distillation
MWD	Metropolitan Water District
MWH	formerly Montgomery Watson, Harza
PET	polyethylene terephthalate
POL	Petroleum, Oil, Lubricant
RFP	Request for Proposal
RMA	Risk Management Association
RO	Reverse Osmosis
TDS	Total dissolved solids
UAF	University of Alaska, Fairbanks
USGS	United States Geological Survey
VC	Vapor Compression
UN	United Nations
WTP	Water Treatment Plant

Executive Summary

In June of 2003, The Denali Commission, based in Anchorage, Alaska, requested a study of *the rural development opportunities, costs, and logistics of shipping and marketing new domestic water supplies outside of Alaska*.

Northern Economics, Inc., also based in Anchorage, submitted a successful proposal, with the assistance of MWH (formerly Montgomery Watson Harza), consulting engineers, and Alaska's Best Water, a water-bottling firm serving markets in Southcentral Alaska.

Project Tasks

The Denali Commission requested specific responses to 12 different tasks, as listed in the Request for Proposal (RFP):

1. Conduct a literature search of government and private studies and reports from the past 10 years.
2. Identify and analyze three market segments: bulk water, non-premium bottled water and premium bottled water.
3. Analyze competition for potential Alaska water exporters.
4. Specify Alaska's water export potential.
5. Conduct an analysis of bulk water transportation via tanker, barge, and bag.
6. Develop capital and operating costs.
7. Discuss bulk versus bottled water operations.
8. List Alaska water sources.
9. Develop and list the regulatory framework for processors, both state and federal.
10. Project likely costs of distribution and marketing.
11. Prepare a set of pro forma financial statements.
12. Describe public benefits from potential water export operations.

Project Results

Project research and analysis generated several key points, listed below and discussed in greater detail within the full report.

- Alaska has a considerable freshwater resource, much of it near tidewater.

- Southern California is the nearest bulk water market, with Los Angeles, Long Beach and San Diego considered potential off-loading sites.
- Bulk water export via tanker appears to be more feasible than pipelines, barges, or water bags, given the distances from Alaska's ports to southern California.
- Bulk water cost, delivered by tankers, is more expensive than current desalination costs in the southern California area.
- The long term cost trends for on-water (tanker) delivery show rising costs, primarily through increasing labor and fuel costs.
- Desalination costs show a steady downward trend, especially since the early 1990s, and that trend is expected to continue.
- Increasingly, bottled water is becoming a commodity, due to highly efficient plants operated by major bottlers such as Pepsi and Coca-cola, Vivendi, and other low-cost producers.
- Alaska's water bottlers face high transportation costs to most markets, markets that are already served by major low-cost producers.
- Bottled glacial water has significant market appeal in domestic and export markets, especially in Southeast Asia.

Water Resources

Global water use shows wide variation among the three principal uses—agriculture, industry, and municipal/human use. Water supplies vary with geography, latitude, climate, and elevation, and are expressed in terms of cubic meters of water resource per capita.

<u>Global, Pacific Rim, Alaska</u>

Greenland, at one extreme, has over 10 million cubic meters of fresh water per person, while Kuwait, at the other extreme, only has 10 cubic meters of water resource per person. On average, the U.S. has 10,837 cubic meters of water resource per capita, while Alaska has 1,563,168 cubic meters per capita (second only to Greenland).

Pacific Rim countries have a wide variety of population and water supply. Countries (states) with an abundance of water include Vietnam, Russia, Hawaii, Alaska and Canada. Countries with less water include South and North Korea, China and Taiwan, and Japan.

Alaska has considerable volumes of high quality, freshwater, both on a per capita and absolute basis. In 1980, the USGS estimated "Alaska contains more than 40 percent of the Nation's surface-water resources."

Water Industry

For this project, the water industry was segmented into bulk and bottled groups, discussed below.

Bulk Water Export

Bulk water delivery within Alaska and other locations can be as simple as 5-gallon bottled water delivery by trucks, such as that provided by ABW in Southcentral Alaska. Another common method is delivery by tanker trucks in parts of rural Alaska, including Bethel, Fairbanks, Homer, and even Ketchikan. Trucks capable of hauling 500 and 1000-gallon loads deliver potable water to homes (or businesses) for storage in cisterns or special water tanks.

For purposes of this project, bulk water export was defined as raw water loaded in Alaska and transported to specific markets out of state. Southern California was selected as the nearest destination for costing purposes.

Bottled Water Process, Market Summary, Export

Water bottling is relatively straightforward. First, water is drawn from one of several possible sources; second, depending on raw water characteristics, it may or may not be filtered, purified, or treated (for bacteria); and, third, it is bottled, labeled and distributed to market.

Bottled water sales and consumption has shown a steady increase over the past ten years, with annual growth in the 8 to 10 percent per year range. As the market has grown, soft drink bottlers, such as Pepsi and Coca-Cola have entered the market and used their economies of scale to become low-cost producers.

Bottled water has been shipped from Anchorage to Japan, where there is relatively strong market interest for glacial and Alaska water.

Regulatory Framework

Export water quality—raw or food-grade—will determine which set of regulations, federal or state, will apply. Raw bulk water has the least regulatory oversight. Bottled water is regulated by the federal Food and Drug Administration as a food product, while tap water is regulated by the U.S. Environmental Protection Agency and is regarded as a utility.

Water is classified as “bottled water” or “drinking water” if it meets all applicable federal and state standards, is sealed in a sanitary container, and is sold for human consumption. Bottled water cannot contain sweeteners or chemical additives (other than flavors, extracts or essences) and must be calorie-free and sugar-free.

Public Benefits

Public benefits from either type of water processing include jobs, taxes, royalties, and conservation fees. These are highly dependent on the specific type of process, how it is funded, and organization of the local public sector.

The state, with conservation fees of $10 per acre-foot (estimated) is not likely to receive significant revenues from water bottling plants. Bulk water exports of 45 acre-feet per tanker would generate $450 in conservation fees per export shipment

If Sitka receives $0.01 per gallon in royalties (similar to a current contract), a single tanker carrying 14.7 million gallons of water would generate $147,000 in payment to Sitka.

Financial Analysis, Results

Exports of raw bulk water are not cost-competitive at this time with current desalination technology, although the political process often incorporates other measures and values in the decision making process. Bottled water exports are feasible and sales to countries such as Japan and Taiwan could capitalize on Alaska's image and its glaciers.

Bulk Water Costs

Bulk water costs were estimated based on markets in southern California, a 2,096 nautical mile trip, served by bulk water from Sitka. Capital costs for 18 single-hulled tankers capable of 620 total trips per year are $270 million. Operating and maintenance costs, including a royalty cost of $0.01 per gallon in Sitka and amortized capital, suggest delivered costs of raw water would be $9,600 per acre-foot. Treatment to potable standards at Long Beach adds $1,000 for an estimated total cost of $10,600 per acre-foot.

Current costs for desalinated water in southern California range from $130 per acre-foot (brackish water) to $1,200 per acre-foot for saltwater. Water distribution costs of $100 to $300 per acre-foot suggest a range of $230 to $1,500 per acre-foot.

At these costs, the delivered price of Alaska water would be at least seven times more expensive than the competitive process.

Bottled Water Costs, Revenues

Bottled water plants are viable businesses in Alaska. In most instances, local Alaskan markets provide base demand and revenues. Exports, if successful, are an incremental increase in production. Bottled water from sites with glacier water and access to container shipping can be a viable export business. For example, Anchorage has Eklutna Glacier water and Port of Anchorage container berths.

A bottled water plant, producing and selling 300,000 cases per year and capable of growing to 400,000 cases annually, could generate $1.5 million in revenue. However, at the limited scale of production used by the model, plant operations would generate a profit of $62,500 before taxes.

The bottled water analysis assumes that:

- The business has about $4.2 million in total assets, including $500,000 of bottling and packaging equipment, a 9,000 square foot building for operations and warehousing valued at $1,000,000, and $35,000 in office and delivery equipment.
- Other assets include cash and cash equivalents, inventory, and other assets related to operations.
- Five people are employed to cover all aspects of production, marketing, and administration.
- The business produces 300,000 cases of water annually, at a cost of $2.67 per case, and sells each case for $5.00 wholesale.

Under these assumptions, the business has revenues of $1.5 million.

Sensitivity analyses and simple break-even calculations are included in the main report. Two appendices provide information on a literature search (Appendix A) and water conversion factors (Appendix B). A full version of bulk water cost assumptions and calculations is included as Appendix C.

Introduction, Discussion

In June of 2003, The Denali Commission, based in Anchorage, Alaska, requested a study of *the rural development opportunities, costs, and logistics of shipping and marketing new domestic water supplies outside of Alaska*.

The project report would be a single source of information on the potential for water processing and export from Alaska, for both bulk and bottled operators. A prospective water bottler or shipper could take the report and use it to identify opportunities and constraints, along with order-of-magnitude costs.

Northern Economics, Inc., also based in Anchorage, submitted a successful proposal, with the assistance of MWH (formerly Montgomery Watson Harza), consulting engineers, and Alaska's Best Water, a water-bottling firm serving markets in Southcentral Alaska.

The Denali Commission

The Denali Commission was established in 1998 as a joint federal-state partnership with five assigned areas of improvements (www.denali.gov):

1. Energy
2. Health Care Facilities
3. Training
4. Intergovernmental Coordination
5. Other Infrastructure projects such as economic development, telecommunications, washeterias, and multi-use facilities

These objectives are consistent with the Denali Commission's mandate *to provide critical utilities, infrastructure, and economic support throughout Alaska*.

Water export, either as bulk or bottled water, is a potential development for many parts of Alaska. Existing facilities in such places as Metlakatla, Hyder, Ketchikan, Sitka, Hatcher Pass, and Juneau are examples. With its many miles of coastlines and deep-water ports, export water is another resource that Alaskans could ship to water-stressed countries, especially in the Pacific Rim area.

Project Tasks

The Denali Commission requested specific responses to 12 different tasks, listed in the Request for Proposal (RFP). These tasks are paraphrased as follows:

1. Conduct a literature search of government and private studies and reports from the past 10 years.
2. Identify and analyze three market segments: bulk water, non-premium bottled water and premium bottled water.
3. Analyze competition for potential Alaska water exporters.
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Project Scope

Rural Alaska is defined by the Commission (www.denali.gov) as those areas that experience three criteria:

- The difficulty and cost of importing and exporting products, traveling to, and communicating with, urban centers because of distance
- The absence of, or inadequate public infrastructure
- A "one industry" village or community with a small population located in proximity to a natural resource and having cheap labor

All of Alaska, at specific times, meets the definition of *rural*. Even Anchorage has experienced difficulties with freight and passenger delivery due to strikes, bad weather, and port security issues.

Much of Alaska is remote, with no access, except by air, and is subject to weather extremes such as wind, ice, extreme cold, and rain. For purposes of this report, all of Alaska was considered as rural.

Project team members evaluated trends, where possible, to the years 2020 or 2025, based on the best available information.

Project Team

To help meet specific Denali Commission task requirements, Northern Economics obtained the assistance of Alaska's Best Water and engineers from MWH.

Alaska's Best Water has provided water bottling and delivery services in Anchorage since 1983; its twenty years in business has included several analyses of export of bottled water to South Korea and other out-of-Alaska locations.

Mike Alfano, General Manager of Alaska's Best Water (ABW), provided assistance, and his company's 20 years of operating experience with water bottling, distribution, and marketing.

MWH (formerly Montgomery Watson Harza) has extensive experience worldwide with all sizes of water delivery systems, from small water haul systems in Alaska villages to piped distribution systems in large metropolitan areas. In Alaska, MWH has completed over 200 water and wastewater projects since 1987. Representative projects include washeterias and a water treatment plant (WTP) in Tanana and Anchorage's Eklutna WTP. Greg Magee, P.E. and MBA, from the Anchorage office, provided assistance on the bulk water export portion of the study.

Northern Economics Inc.'s project team included Cal Kerr, Project Manager, and Pat Burden, President of Northern Economics, who served as project economist. Mike Fisher, Analyst, prepared financial and sensitivity analyses.

Project Results

Project research and analysis generated several key points, shown below and discussed in greater detail within major report sections:

- Alaska has a considerable freshwater resource, much of it near tidewater.
- Southern California is the nearest bulk water market, with Los Angeles, Long Beach and San Diego considered potential off-loading sites.
- Bulk water export via tanker appears to be more feasible than pipelines, barges, or water bags, given the distances from Alaska's ports to southern California.
- Bulk water cost, delivered by tankers, is more expensive than current desalination costs for freshwater production in the southern California area.

- The long term cost trends for on-water (tanker) delivery show rising costs, primarily through increasing labor and fuel costs.
- Desalination costs show a steady downward trend, especially since the early 1990s, and that trend is expected to continue.
- Increasingly, bottled water is becoming a commodity, due to highly efficient plants managed by major bottlers such as Pepsi and Coca-cola, Vivendi, and other low-cost producers.
- Alaska's water bottlers face significant transportation costs to markets already served by major low-cost producers.
- Bottled glacial water has significant market appeal in domestic and export markets, especially in southeast Asia.

Project Research, Sources

Appendix A contains references and citations used for this project. Although there are over 200 separate references, they are representative of the major water-related topics from the last ten years.

Topics such as water supplies, water use, allocation, distribution, and health and sanitation are very current and likely to become more significant in the next 20 years.

Conversions

Water is measured in many different units, from gallons of volume, to pounds of weight, including acre-feet, liters, and cubic meters. A full set of conversion tables is contained in Appendix B.

Worldwide, water volumes are measured in cubic meters and costs are generally expressed as U.S. dollars per cubic meter. Within the U.S., acre-feet (the volume of water need to cover an acre of land to a one-foot depth) and units of 1,000 gallons are common.

Common conversions are as follows:

- 1 cubic meter of water contains 1,000 liters or 264.2 gallons
- 1 acre-foot of water is 325,900 gallons or 1,233 cubic meters
- 1,000 gallons of water is 3.8 cubic meters

Report Organization

This report is organized in major sections and subsections, as generally described below.

Introduction, Discussion. This section provides background on the project (including tasks, scope, and the team), this report, and general findings, as well as common water conversion factors.

Water Resources. Global water uses, resources, and specific water-rich countries are identified, along with water issues such as continuing population growth and increased water demand.

Pacific Rim Water Resources. Countries and states along both sides of the Pacific Ocean area are noted as to water resources and potential demand for Alaska water. In specific, California's southern water demand is discussed in detail.

Alaska Water Resources. Alaska's water-rich status is noted, along with the first bulk water export (ice) in 1852. Water resources and market preferences are discussed.

Water Industry. Process and market attributes of both the bulk and bottled water industry segments are discussed in this section.

Regulatory Framework. Federal and state oversight of the bottled (and bulk) water industries are presented in this section, including special measures for glacial water and glacial ice.

Financial Analysis. Capital and operating costs, including maintenance, are presented in this report section, with pro forma financial statements, sensitivity analyses, and a break-even analysis.

Summary, Market Opportunities. Alaska's bulk and bottled water potentials are summarized in this section.

Water Resources

Global water supply and use varies by country location, population density and degree of development. This section provides a picture of global, regional (Pacific Rim), and local Alaska water supply and use estimates, in descending geographical order.

Global water use shows wide variation among the three principle uses (agriculture, industry, and municipal – human use). Basic human needs are approximately 50 liters per day for drinking water, sanitation, bathing, and food preparation.

Water supplies vary with geography, latitude, climate, and elevation, and are expressed in terms of cubic meters of water resource (ice, rivers, lakes, sub-surface water) per capita.

Greenland, at one extreme, has over 10 million cubic meters of freshwater per person, while Kuwait, at the other extreme, only has 10 cubic meters of water resource per person. On average, the U.S. has 10,837 cubic meters of water resource per capita, while Alaska has 1,563,168 cubic meters per capita (second only to Greenland).

Water stress occurs when water supplies drop below 1,700 cubic meters per person, with scarcity defined as less than 1,000 cubic meters per person of annual supply.

Information on global water resources is presented in more detail within the following sections.

Global Water Use

According to the World Bank,[1] world freshwater uses are categorized as shown in Table 1.

Table 1. Aggregate Water Use, World Averages.

Water Use	Percent of Total
Agriculture	70
Industry	20
Municipal	10

The World Bank's averages include a six-fold increase (per capita) over the past century, worldwide. They do not account for high variability among (and within) countries. The bank noted:

> *These increases have come at high environmental costs; some rivers no longer reach the sea; 50 percent of the world's wetlands have disappeared in*

[1] "World Bank Endorses Water Resources Strategy," News Release February 27, 2003.

> *the past century and 20 percent of freshwater fish are now endangered or extinct. Many of the most important groundwater aquifers are being mined, with water tables already deep and dropping by meters every year, and some are damaged permanently by salinization. Without appropriate action taken to address the situation****, four billion people–one half of the world's population–are expected to live under conditions of severe water stress in 2025****, particularly in Africa, the Middle East, and South Asia.* [Emphasis added].

Other attributes of these three main water uses are discussed in the following subsections.

Agriculture

Food self-sufficiency consumes an estimated 900 cubic meters of water per person per year, well beyond the amount available in semi-arid countries within Africa and Asia. Forecasts for the next 30 years suggest water scarcity will make these regions, home to 55 percent of the world's population, more dependent on food imports[2]. Africa and Asia have two of the highest regional birth rates in the world.

Agricultural water quality needs are less stringent than those for human consumption. Parts of the world, such as Israel, use reclaimed sewage and non-contaminated industrial process water for agricultural production.

Industrial

Traditionally, industrial water use has been tied to industrial activity as an indicator of prosperity[3]. As Gross Domestic Product (GDP) increased, there was a parallel increase in water consumption by industrial firms.

However, recent technological advances have reduced water consumption in many industries, such as the steel and food industries. There is no longer the direct one-to-one linkage between GDP and industrial water use.

Municipal

The minimum amount of water needed for human life ranges from 20 to 40 liters (freshwater) per day, for drinking and sanitation (hygiene) alone. The World Bank, the World Health Organization

[2] Ibid.

[3] "The World's Water, 2002-2003" Peter Gleick, Island Press, 2003.

and the United Nations set these targets. However, these volumes exclude water for cooking and personal hygiene.

The quantities in Table 2 suggest a minimum of 50 liters per person per day (18.3 cubic meters per person per year), for four essential uses, including personal hygiene.

Table 2. Recommended Basic Water Requirement

Purpose	Liters per Person per Day
Drinking Water	5
Sanitation Services	20
Bathing	15
Food Preparation	10
Total	**50**

Peter H. Gleick, *Basic Water Requirements for Human Activities: Meeting Basic Needs*, in Water International, International Water Resources Association, 1996.

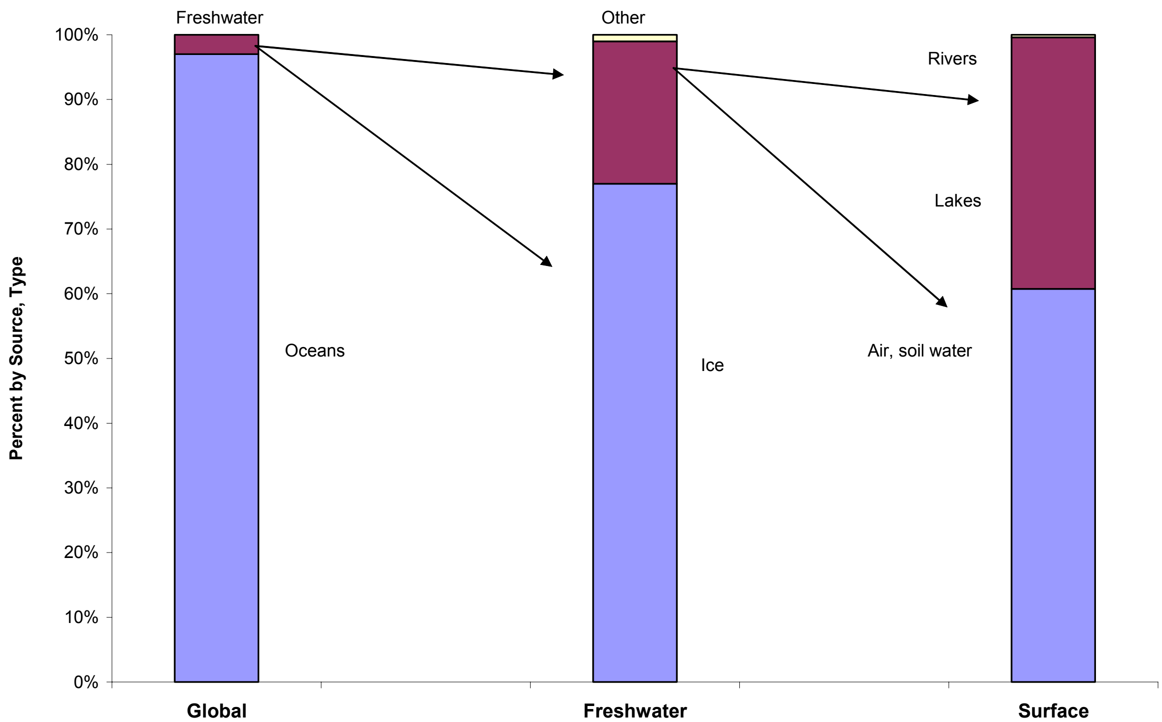
As a point of comparison, one Anchorage subdivision, with its own water system, distributes water to approximately 250 homes. Over seven years, metered water consumption per home has averaged about 264 gallons or almost exactly one cubic meter (1,000 liters) per day.

At three people per home, the per capita water consumption in this Anchorage subdivision is 88 gallons or 330 liters, about six times the established basic water requirement shown in Table 2.

Global Water Resources

The earth is covered with water, estimated at 70 percent of the world's surface area. However, only 3 percent of that water is freshwater, with the rest contained in the Earth's oceans. Figure 1 illustrates the earth's freshwater distribution.

Figure 1. The Earth's Water Distribution.



Source: U.S. Geological Survey, http://ga.water.usgs.gov/edu/mearthall.html. Accessed October, 2003.

Freshwater that readily supports human life, agriculture and industry is located in ground water, surface water, and the various icecaps and glaciers in Alaska and other countries. Alaska alone contains approximately 75,000 square kilometers of glaciers[4].

Overall, there is sufficient freshwater for human use on an annual basis.

One estimate[5] suggests between 12.5 and 14 billion cubic meters of water are available on an annual basis, or about 9,000 cubic meters per person per year, for all uses (agriculture, industry, etc.). This same methodology suggests only 5,100 cubic meters per capita will be available in the year 2025.

Since freshwater is not evenly distributed, there are considerable supply disparities now, and they appear likely to get worse as population increases and global warming changes traditional weather and water patterns.

[4] http://nsidc.org/glaciers/quickfacts.html. Accessed October 10, 2003.

[5] "Solutions for a Water-short World," Population Information Program, Johns Hopkins School of Public Heath, September, 1998.

Water-Rich Countries

Table 3 lists selected countries in terms of per capita water supply. Unlike thresholds for water stress and scarcity, there are no defined levels of abundance.

Table 3. Selected Water Rich Countries, Population and Cubic Meters of Water per Capita, 2000.

Country	Continent	Population	Water per Capita
Greenland	N C America	56,000	10,767,857
Alaska, USA	N C America	626,932	1,563,168
Papua New Guinea	Asia	4,809,000	166,563
Canada	N C America	30,757,000	94,353
New Zealand	Oceania	3,778,000	86,554
Belize	N C America	226,000	82,102
Peru	South America	25,662,000	74,546
Laos	Asia	5,279,000	63,184
Chile	South America	15,211,000	60,614
Panama	N C America	2,856,000	51,814
Colombia	South America	42,105,000	50,635
Fiji Islands	Oceania	814,000	35,074
Ecuador	South America	12,646,000	34,161
Russian Federation	Europe	145,491,000	30,980
Costa Rica	N C America	4,024,000	27,932
Malaysia	Asia	22,218,000	26,105
Australia	Oceania	19,138,000	25,708
Hawaii, USA	N C America	1,211,537	15,187
Mongolia	Asia	2,533,000	13,739
Indonesia	Asia	212,092,000	13,381
Viet Nam	Asia	78,137,000	11,406
United States of America	N C America	283,230,000	10,837

Source: United Nations, Food and Agricultural Organization, AQUASTAT, 2003.

As Table 3 shows, the United States average is 10,837 cubic meters per person, with Alaska and Hawaii listed separately due to their unique water resources and smaller populations.

Water Stress and Scarcity

Water stress and scarcity are measured in terms of available annual supply per capita:

- *Water stress* occurs when annual supplies drop below 1,700 cubic meters per person.
- *Water scarcity* is defined as annual water supplies under 1,000 cubic meters per person per year.

- *Water shortages* or rationing can be expected between the two figures[6].

Africa and Asia are currently listed in those categories of water stress and scarcity, as shown in Table 4. Not all countries in the world are shown.

Table 4. Africa and Asia, Selected Countries, with Water Stress, Scarcity, Cubic Meters of Water Per Capita, 2000.

Continent and Country	Estimated Population	Water per Capita
Africa		
Libyan Arab Jamahiriya	5,290,000	113
Egypt	67,884,000	859
Morocco	29,878,000	971
Kenya	30,669,000	985
South Africa	43,309,000	1,154
	Weighted Average	**947**
Asia		
Kuwait	1,914,000	10
Gaza Strip (Palestine)	1,077,000	52
Saudi Arabia	20,346,000	118
Singapore	4,018,000	149
Jordan	4,913,000	179
Israel	6,040,000	276
Cyprus	784,000	995
Korea, Republic of	46,740,000	1,491
Pakistan	141,256,000	1,576
Syrian Arab Republic	16,189,000	1,622
	Weighted Average	**1,232**

Source: United Nations, Food and Agricultural Organization, AQUASTAT, 2003.

The FAO database suggests countries currently experiencing water stress or scarcities are concentrated in Africa and Asia. Many of these countries are potential markets for Alaska's water or, conversely, they have developed alternative water production that is competition for water delivered from Alaska. Israel, with its heavy dependence on desalination (salt removal) of salt water, is such an example.

Many parts of the world, including the United States, have invested in reverse osmosis water purification (membrane purification), a system that produces water in the $0.55 to $0.70 cost per cubic meter. Equivalent costs are $700 to $900 per acre-foot or $2 to $3 per 1,000 gallons, as shown in Table 5. Generally, water costs are quoted in most of the world as U.S. dollars per cubic meter. Appendix B contains more detailed conversion factors.

[6] "Solutions for a Water-Short World," John Hopkins University, 1998.

Table 5. Selected Conversion Costs, $ per Acre-foot, 1,000 gallons and Cubic Meter.

$/Acre-foot=>	$/1000 gallons =>	$/cubic meter
400	1.23	0.32
600	1.84	0.49
800	2.45	0.65
1,000	3.07	0.81
1,200	3.68	0.97
1,600	4.91	1.30
2,000	6.14	1.62

Water Issues

In 1992, the UN's Dublin Conference declared "Water has an economic value in all its competing uses and should be recognized as an economic good." Others have opposed this view, suggesting water is both a social and economic good.

Other policy issues include:

- Water rich versus water poor countries
- Developed versus undeveloped countries and water consumption
- Future for water use – by sector (agricultural, industrial, and human)
- Globalization of water trade
- Global warming impacts on water supply
- Privatization of water supply and distribution
- Large water dams
- Population growth

Generally, there is agreement that the highest priority water use is maintaining human life, followed by all others.

Although the issues noted above are beyond the scope of this project, they will have a major impact on world water use policies in the next several decades.

Pacific Rim Water Resources

Pacific Rim water resources for selected countries are discussed in this section. Regional, or Pacific Rim, population and relative water supplies (in cubic meters per capita) are shown in Table 6. Unless otherwise noted, these are based on country averages.

West Coast United States population consists of Washington, Oregon, and California; however, the water supply shown is based on the U.S. national average. Water supply information for specific states, such as the three West Coast U.S. states, is not readily available; population figures, however, are available by state and are shown. Water supply information for Alaska and Hawaii is available and is shown.

Table 6. Pacific Rim Countries, with Population and Water Supply, Cubic Meters Per Capita, and Per Capita Gross Domestic Product (GDP), 2000.

Pacific Rim Country	Population	Water Supply Per Capita	Per Capita GDP ($)
Vietnam	78,137,000	11,406	2,100
China	1,252,952,000	2,258	4,300
Taiwan	22,181,000	3,021	17,200
Japan	127,096,000	3,383	27,200
South Korea	46,740,000	1,491	18,000
North Korea	22,268,000	3,464	1,000
Russia	145,491,000	30,980	8,300
Hawaii	1,211,537	15,187	36,300
Alaska	626,932	1,563,168	36,300
Canada	30,757,000	94,353	27,700
West Coast, U.S.	43,187,168	10,837	36,300
Mexico	98,872,000	4,624	9,000

Source: AQUASTAT, United Nations Food and Agricultural Organization, 2003. Census 2000, U.S. Census Bureau; “The World Factbook” U.S. Central Intelligence Agency, 2003.

Pacific Rim countries have a wide variety in population and water supply. Countries (states) with an abundance of water include Vietnam, Russia, Hawaii, Alaska, Canada and the west coast of the United States. Countries with fewer water supplies include South and North Korea, China and Taiwan, and Japan.

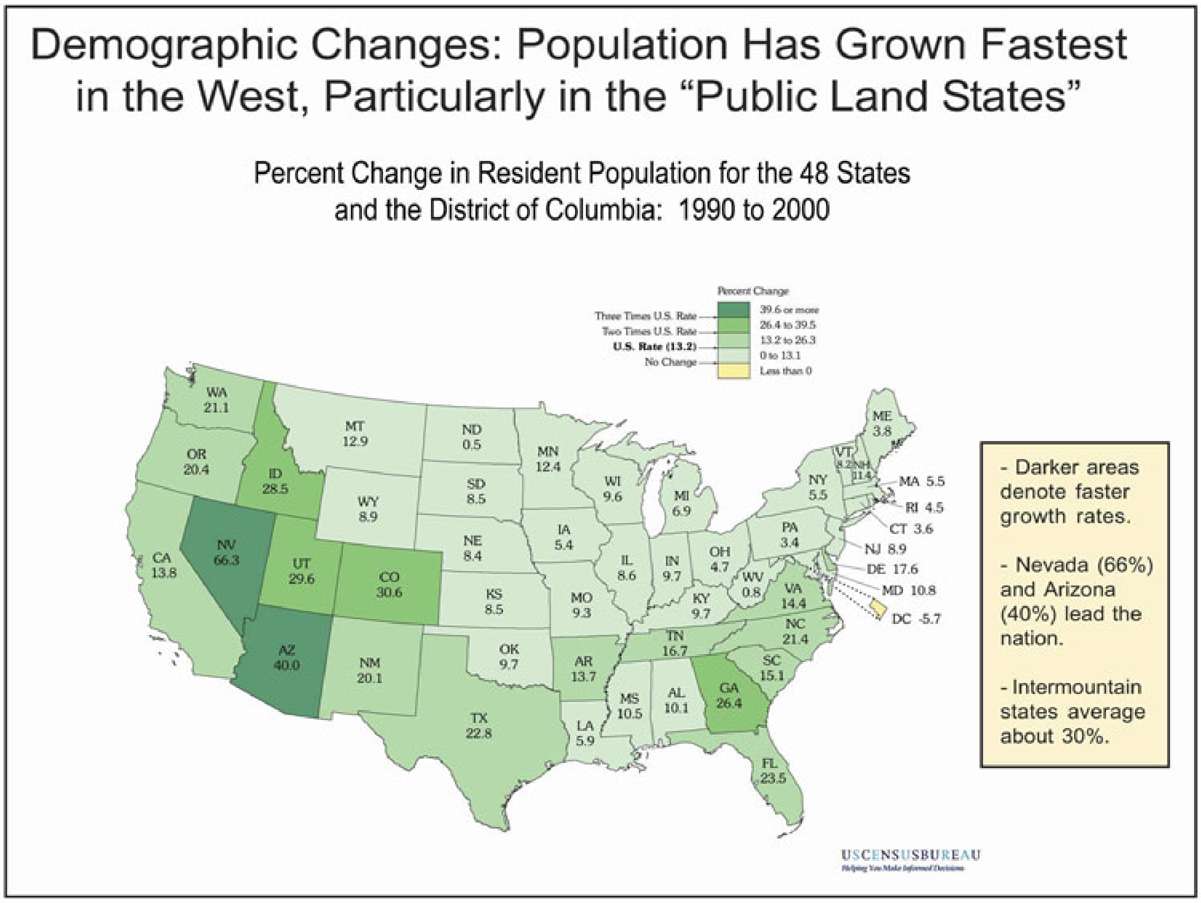
The column headed with per capita GDP provides an estimate of economic development. Generally, more developed countries have more internal funds available for water provisioning. Poorer countries often seek external funds, such as loans from the World Bank.

Washington and Oregon have smaller populations than California and overall less demand for water.

California Water Demand

Southern California's warm, dry climate, as well as similar conditions in adjacent areas such as New Mexico and Nevada (especially Las Vegas), has contributed to considerable net in-migration in the past 10 to 15 years. Figure 2 illustrates population growth in the contiguous U.S. for the period 1990 to 2000.

Figure 2. Population Growth, Contiguous United States, 1990 to 2000.

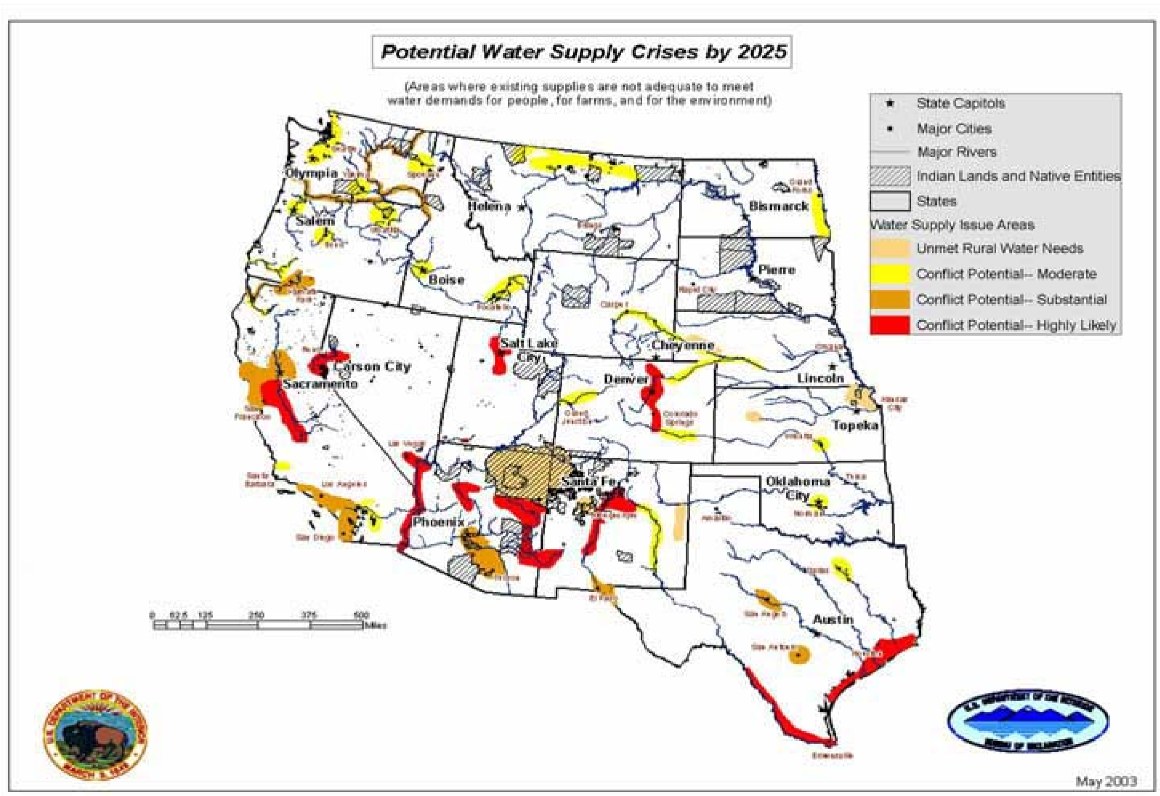


Source: U.S. Census Bureau, http://www.doi.gov/water2025/populate.html, accessed December 23, 2003.

A major water source for California, Nevada, and New Mexico is an allocated portion of water from the Colorado River. Homeowners in San Diego, for example, are likely to drink water from the Colorado, shipped to the Los Angeles area and, eventually, to San Diego via a series of aqueducts.

Other sources of water for the drier portions of southern California are inter-basin transfers from the northern part of the state. However, the overall picture of water supply for California to the year 2025 suggests increasing conflicts and higher demand for freshwater. Figure 3 illustrates potential water crises by 2025.

Figure 3. Potential Water Supply Crises, by 2025, Western U.S.



Source: U.S. Department of Interior, Bureau of Reclamation, http://www.doi.gov/water2025/supply.html, accessed December 23, 2003.

Conflicts in the San Francisco area are considered highly likely, while there is potential for substantial conflict from Los Angeles south to San Diego.

Alaska Water Resources

As shown in the two prior sections, Alaska has considerable volumes of freshwater, both on a per capita and absolute basis. In 1980, the USGS estimated "Alaska contains more than 40 percent of the Nation's surface-water resources.7 The State's average annual precipitation is about *1,050,000 million gallons [one trillion] per day, with an average annual surface runoff of about 989,000 million gallons per day*.8

Water export from Alaska is not new, however. The first water export started with the Russians, as bulk ice shipped to west coast cities.

Early Russian Water Exports

Bulk water export from Alaska began during the Russian era, as export ice. Slabs of ice were cut, stored in sawdust within icehouses, and eventually shipped to California and other markets.

The Russian America company operated an ice company in Alaska for 28 years. Initially established at Sitka, it moved to Woody Island in 1855, near Kodiak, and shipped ice to California, Mexico, and the Sandwich Islands (Hawaii).[9] The first shipment to California (San Francisco), displacing ice shipped from Boston, was so successful that the Russian America Company agreed to furnish 1,000 tons annually at $35 per ton.

That first shipment was made in February, 1852, from Woody Island to San Francisco. At $75 per ton, the initial cargo was 250 tons, for a total sale of $18,750. Ice was cut with a special horse-powered saw and stored in icehouses, covered with sawdust, at Woody Island.

Sample loads of ice from Sitka were tested in 1852 and found to be too soft and thin, at three to four inches thick, and shipped loads had to be supplemented with glacial ice from Baird Glacier near Petersburg.

Woody Island produced 19,200 tons of ice in the six years that ended July 1, 1860; annual production reached 6,000 tons. By July 1, 1862, 25,500 tons of ice were exported with total revenue reaching $250,000.[10] Freight charges ranged from $7 to $8 per ton.

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[7] Alaska Surface-Water Resources, National Water Summary, U.S. Geological Survey, circa 1980.

[8] Alaska Water Supply and Use. National Water Summary, U.S. Geological Survey, 1987.

[9] "The Woody Island Ice Company" by Gary Stevens. "Russian in North America" Proceedings of the 2nd International Conference on Russian America, Sitka, Alaska. August 19-22, 1987. Edited by Richard A. Pierce. Limestone Press. 1990.

[10] Ibid. Page 198.

An American, Frederick Whymper, visited Kodiak shortly before the 1867 sale of Russian America to the United States. He recorded the ice cutting process and commented on end-product markets in San Francisco, Mexico, and Central and South American ports. The ice company was purchased in 1867 by the American Russian Commercial Company. In 1868, total ice capacity was 12,000 tons in three icehouses. In 1869, ice was priced in San Francisco at five cents per pound and customers balked at the high price.

Artificial ice making began in 1871 and that started a price war in San Francisco, with Woody Island ice prices dropping to two cents per pound. Subsequently, the ice cutting business declined and it ceased operations by 1879.

Lessons Learned, Ice Exports

Although this project took place over 150 years ago, there are lessons from the Russian ice business:

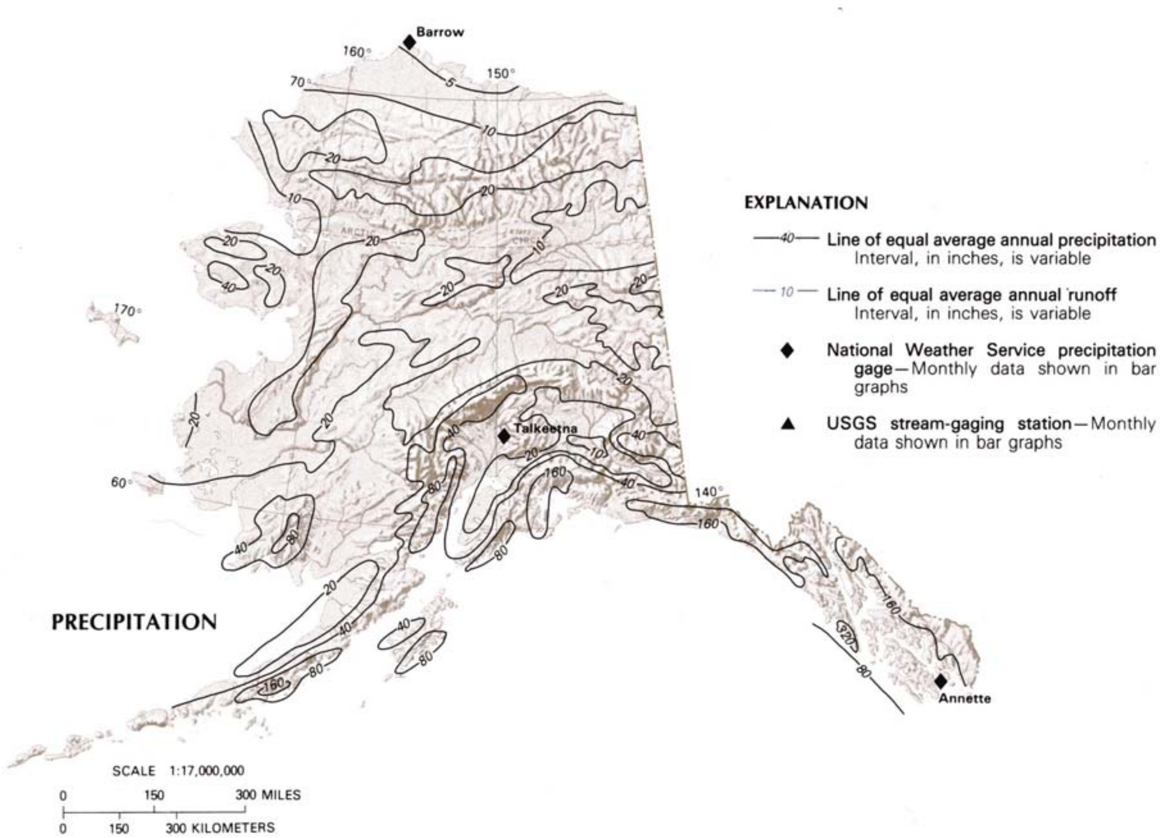
- Successful water exports (whether bulk or bottled) must overcome Alaska's distance from many markets
- Export water competitiveness is subject to technological advances, whether artificial ice-making in 1871 or cheaper desalination plants in the current time
- Alaska has relatively limited local markets and must depend, at some point, on exports for business expansion
- Alaska has strong name recognition; its water (and ice) has generated a favorable response from many consumers since 1852, but price is always a consideration
- Alaska's association with glaciers, such as Baird Glacier, is a strong linkage for bottled water buyers

Alaska's Precipitation

Figure 4 illustrates Alaska's precipitation in inches per year. With a land area of 586,000 square miles (1,518,000 square kilometers), there is wide variation in precipitation; from under 10 inches in the Arctic to over 300 inches per year in parts of Southeast Alaska.

In addition to surface water runoff, Alaska had 28,500 square miles of glaciers and ice fields in 1971 (Post and Mayo). There is evidence that global warming might be a cause of recent melting and calving, reducing the area and volume of Alaska's glaciers.

Figure 4. Alaska Precipitation



Source: USGS

Alaska's River Systems

Alaska's larger rivers drain a large portion of the state. Alaska's four climatic zones have the following precipitation patterns:

- Maritime. Precipitation estimated at 67 percent of the total occurs from September to March. Ketchikan and Sitka are cities within this zone, as are Kodiak and the Aleutian chain.
- Continental and Arctic. About two-thirds of the precipitation occurs from June to November. The Yukon and Colville rivers are representative of these areas.
- Transition. This zone includes areas such as Anchorage that lie between the drier continental zone (north) and the maritime area (south).

Average rainfall for Alaska is 25 inches per year but a significant range exists, from 4 inches along the Arctic coast to 300 inches for area such as Little Port Walter in Southeast Alaska.

Table 7 illustrates these rivers by area within Alaska, along with estimated discharge per second (at the mouth).

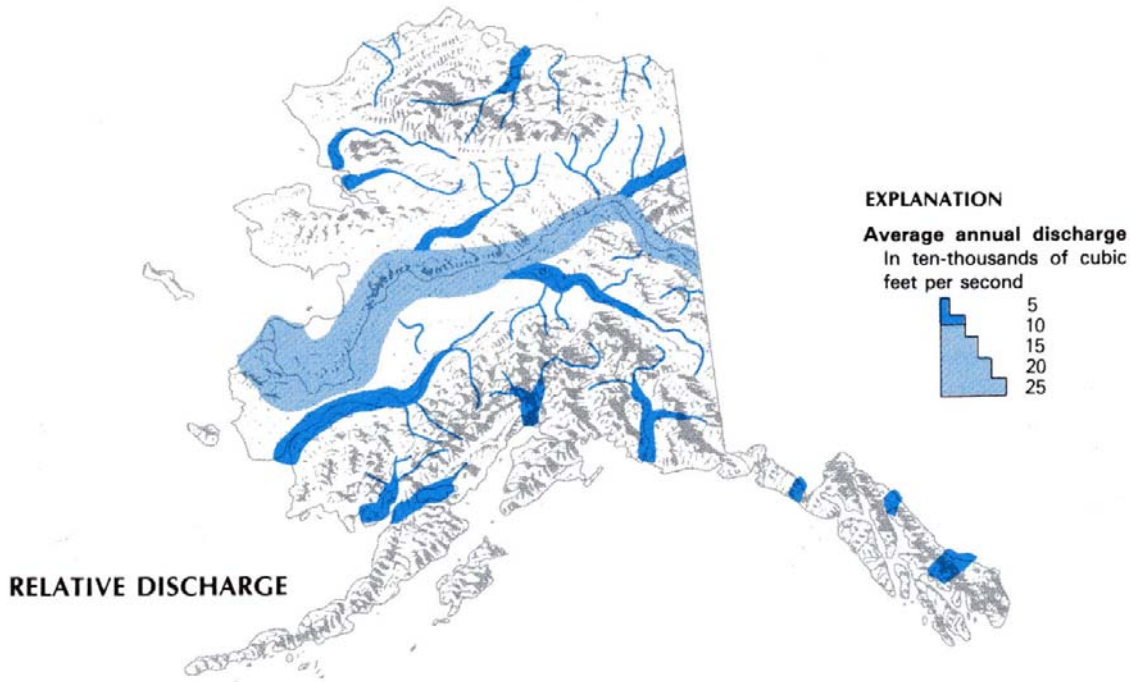
Table 7. Alaska's Largest Rivers, by Area and Estimated Discharge per Second.

River	Area	Discharge in Cubic Feet per second	Discharge in Cubic Meters per second
Stikine	Southeast	56,000	1,977
Taku	Southeast	20,000	706
Alsek	Southeast	30,000	1,059
Copper	Southcentral	59,000	2,083
Chitina	Southcentral	20,000	706
Susitna	Southcentral	61,000	2,154
Yenta	Southcentral	21,000	742
Nushagak	Southwest	32,000	1,130
Kuskokwim	Southwest	67,000	2,366
Yukon	Northwest	225,000	7,945
Porcupine	Northwest	23,000	812
Tanana	Northwest	41,000	1,448
Koyukuk	Northwest	22,000	777
Kobuk	Northwest	18,000	636
Colville	Northwest	20,000	706

Source: Adapted from USGS, Alaska Surface-Water Resources, 1980.

Figure 5 illustrates Alaska's major river systems and their relative discharge, as displayed by the amount of shading.

Figure 5. Alaska's Major River Systems, Discharge.



Source: USGS

Southeast Water Resource

In 1994, the State Department of Natural Resources (DNR) identified Southeast Alaska as a likely source of bulk exportable water.[11] Precipitation ranges from 100 to 300 inches per year, mostly as rain. Surface runoff was estimated at over 300 million acre-feet per year (370 billion cubic meters).

The Southeast sub region has smaller drainage basins, less than 200 square miles, with large basins that extend into British Columbia. The Stikine River is one example. Runoff from this sub region (including the runoff from Canada) is estimated as much as that from the Mississippi River.[12]

[11] Alaska Water Exports. State of Alaska, Department of Natural Resources, June, 1994.

[12] Alaska Surface-Water Resources. U.S. Geological Survey. 1980.

The City of Sitka signed two contracts for bulk water export from the city's water source at Blue Lake and Green Lake. This water source was used for bulk water costing and is explained in greater detail within the report discussion on bulk water.

Southcentral (Anchorage) Water Resources

Southcentral Alaska includes the Port of Anchorage, a receiving port that supplies over 80 percent of the state's population with food, supplies, and fuel. There are other areas in Southcentral with water nearby, such as Cordova, Valdez, Whittier, and Port MacKenzie, but Anchorage has the majority of non-oil tanker vessel traffic, primarily for petroleum products.

Water was exported from the Port in 1994 and is the only known bulk water export from this region. This section focuses on Anchorage's past and potential water export.

Anchorage Water Sources

The Port lies within the Municipality of Anchorage and it obtains water from the municipal water system. Municipal water is drawn from three main sources,[13] listed below with their supplied volumes for 2002:

- Eklutna Water Treatment Facility, 7.9 billion gallons or 79.6 percent of the total supply
- Ship Creek Water Treatment Facility, 299 million gallons or 3 percent of total supply
- Chugach Mountain Range watershed and in-town wells, 1.7 billion gallons or 17.4 percent of the total

The Eklutna and Ship Creek treatment facilities produce up to 65 million gallons of water per day. The Anchorage Water and Wastewater Utility (AWWU) also operates 12 high production wells and nine smaller standby units.

Eklutna water is glacial water, from the Eklutna Glacier, and meets state requirements for labeling as *glacier water*. There is further detail on glacial water in the report section titled Regulatory Framework.

Anchorage Water Treatment

Water produced by AWWU is treated in four steps:

1. Raw water is mixed with soda ash to maintain a pH of 7.7 to 8.0, a range that minimizes corrosion in the distribution system and residential plumbing fixtures.

[13] Anchorage Water Quality Report, Anchorage Water and Wastewater Utility, 2003.

2. Ferric sulfate is added for coagulation and flocculation. As it dissolves, it binds dirt and other floating particles to settle in large basins.
3. Filtration through layers of anthracite coal, sand and gravel removes remaining impurities.
4. Chlorine and fluoride are added to finished water for bacterial treatment and prevention of tooth decay.

AWWU water may be metered and, if so, it is sold at the rate of $2.64 per 1,000 gallons for both residential and commercial consumers. However, AWWU residential water is billed at a flat monthly rate of approximately $50 per home for both water and sewer.

Anchorage Bulk Water Export

In August 1994, AWWU exported water to Japan from the Port of Anchorage. The 1.76 million gallons was loaded via special hoses connected to water points near the Petroleum, Oil and Lubricant (POL) dock. The tanker had loaded a partial-cargo of naphtha, along with water in the remaining holds. The ship was en route to Japan after unloading cargo in California.

The end-product consumer was a Japanese industrial user, facing extreme draught and limited industrial water availability. Grit and sand were greatest concerns for the purchaser, since the water would not be consumed by humans.

Total loading time was 16 hours, due to delays from 30-foot tide fluctuations in Cook Inlet and inadequate water-fill piping.

An engineer at AWWU estimated a 15-million gallon tanker would be a likely limit for any future such sales, due to depth limits in Cook Inlet. The system used would require three 24-hour days to fill a tanker of this size; a faster, quick-fill system was suggested for any future water sales, along with a water reservoir of appropriate size.

Exported water volume was estimated by a marine surveyor and was charged at the rate of $2.64 per 1,000 gallons or $4,650 for the whole load. Two other purchases were attempted but the POL dock was blocked and loading time could not be scheduled.

Aleutian Water Resource

Export bulk water applications were approved by the State Department of Natural Resources in January, 2000 for Adak Island, at the western end of the Aleutian Island chain.

Three sources of surface water were identified near the former Adak military base, totaling a potential removal of 46 million gallons per month (12,200 cubic meters).

The applications indicated water would be gravity fed by pipelines, approximately 11,500 feet in length, to a deep-water port.

Although no actual shipments have been made to date, the permits are still valid.

Market Preference

Water export from Alaska is expected to continue as a spot market commodity, similar to the 1994 shipment from Anchorage. Bulk water purchasers will likely use tankers, in preference to slower tugs or more costly pipelines. The current price in Anchorage is $0.00264 per gallon (treated water) and $0.01 per gallon (untreated) at Sitka.

There are several criteria that define a successful bulk water export candidate:

- High quality water, including low sediment and other dissolved solids, along with a neutral pH (relative acidity), and low bacteria counts
- Sufficient water for bulk export on a *fast fill* basis, to reduce loading time and cost
- Accessibility to a port with terminals that can load bulk fluids such as water

Water Industry

The water industry, including public utilities, has three main participants:

- Water producers such as the City of Sitka
- Water distributors, generally a water utility
- Water bottlers (wholesale, retail; 5-gallon and PET)

Producers are generally public utilities such as Anchorage's Waste and Wastewater Utility (AWWU) that supply water to commercial and municipal end-users. Several, such as the Imperial Valley Irrigation District in southern California, provide water directly to the agricultural industry.

This report section provides more specific information on bulk water suppliers, distributors and water bottlers.

Bulk Water Export

Bulk water delivery within Alaska, and other locations, can be as simple as 5-gallon bottled water delivery by trucks, such as that provided by Alaska's Best Water (ABW) in Southcentral Alaska.

Another common method is delivery by tanker trucks in parts of rural Alaska, including Bethel, Fairbanks, Homer, and even Ketchikan. Trucks capable of hauling 500 and 1000-gallon loads deliver potable water to homes (or businesses) for storage in cisterns or special water tanks.

Water Transport Methods

For purposes of this project, bulk water export was defined as fresh water loaded in Alaska and transported to specific markets out of state. Water tankers capable of hauling up to 15 million gallons via ocean travel were considered most feasible.

Three ways of exporting bulk quantities of fresh water from Alaska were considered: single-hull tankers, water transport bags, and barges.

At this time, towing a giant, reinforced nylon water transport bag by tug, similar in holding capacity to a tanker, was considered more problematic and costly than a tanker. Although there are instances where huge bags have been hauled successfully for short distances by tugs, the technology of hauling bags long distances is not fully proven (McCann, 2000). However, significant advances have been made over the last few years to improve the economics and technical feasibility of water transport bags (Davidge, 2004).

Likewise, exporting large amounts of water by barge was also found to be uneconomical and technically unfeasible due to lower capacity and slower speeds than the tanker alternative.

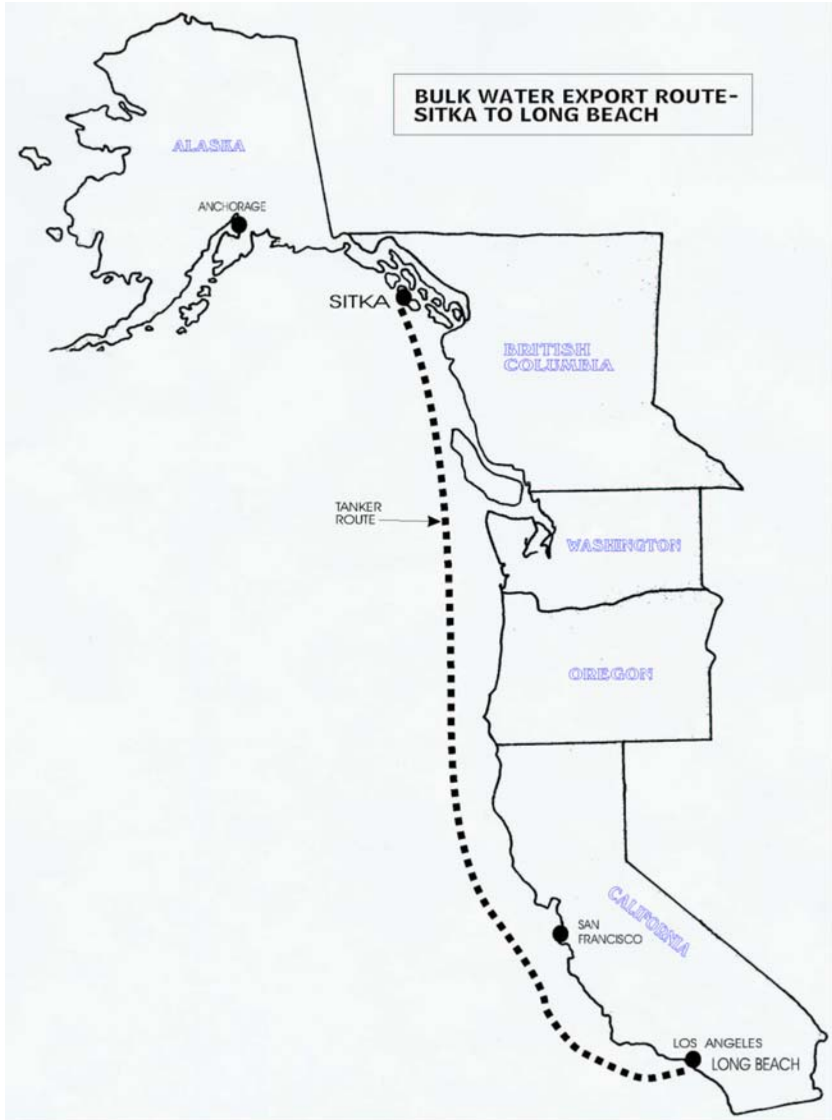
Pipelines were also evaluated, both on-shore and offshore. However the extremely high costs of such pipelines eliminated them at this time. An order-of-magnitude cost estimate in 1992 for an offshore pipeline from southeast Alaska to Lake Shasta in northern California was approximately $160 billion (U.S. Congress, 1992).

Depending on end use, either raw or potable water can be exported from Alaska. However, transporting potable water for drinking water purposes is not feasible because of the high risk of contaminating water during delivery. Even if potable water were exported, then tested, and found safe for drinking upon delivery, drinking water providers would still be required to reprocess water through a water treatment plant before entering a water distribution system.

This would ensure that the water complied with current drinking water standards and is safe for public consumption. Therefore, for the purpose of this study, raw water instead of potable water would likely be exported.

The most promising method of exporting bulk raw water from Alaska is a single-hull tanker. Since the City and Borough of Sitka are actively pursuing bulk raw water sales, and with fresh water supply shortages in southern California, exporting water by tanker from Sitka, Alaska to Long Beach, California was selected as the model bulk water export project for cost estimating. Distance between ports is about 2096 miles. Figure 6 illustrates the proposed water tanker route from Sitka to Long Beach.

Figure 6. Bulk Water Export, Sitka to Long Beach, Tanker Route.



Source: MWH

Sitka's source of water is Blue Lake, which is fed by glacier, snowmelt and rain. Water quality is very good. Blue Lake supplies hydroelectric power and drinking water for the community. Between the lake and the hydroelectric plant is a 72" pipeline, which flows at 552.5 million gallons of water per day. The City and Borough of Sitka have two water export certificates from the State of Alaska, each for 12.5 million gallons per day. Thus, the total water available per year from Sitka for bulk water export is 25,000 acre-feet or 9 billion gallons (Sitka, 2003). However, Blue Lake has the capacity to provide more water.

The loading of raw water at Sitka would occur at the Sawmill Cove Industrial Park, located on the shore of Silver Bay, a large ocean bay.

However, there is no existing dock suitable for holding a tanker for the purpose of loading water. Access to the aqueduct from Blue Lake is less than 2,000 feet from the shore-side dock site at Sawmill Cove. A suitable sized dock and water line would need to be constructed. At the receiving end in Long Beach, port facilities would need to be upgraded and a water pipeline would need to be constructed to tie into the existing water distribution system that provides water for southern California.

Export Bulk Water Markets, Desalination

Southern California is the major market for Alaska's potential bulk water exports. A recent task force report (California Department of Water Resources, 2003) included the following selected key findings:

- California's population is projected to increase by 600,000 per year, largely from natural increases (births minus deaths), which will impact demands for potable water supply.
- Some areas of the State have serious groundwater overdraft problems, adding pressure on existing water supplies to meet agricultural and urban demands.
- Desalination is receiving increased attention as the cost of desalination decreases and the cost of many other water supplies continues to rise.
- There are currently more than 40 brackish groundwater-desalting facilities and generate approximately 170,000 acre-feet per year.
- The total cost for brackish water desalination…will be based on site-specific conditions and currently range from $130 to $1,250 per acre-foot.
- There are currently 16 permitted seawater desalination facilities that generate 4,600 acre-feet per year of desalinated water in California.
- The costs for new seawater and estuarine water desalination...range from $700 per acre-foot (energy costs of $0.05 per kWh) to $1200 per acre-foot (energy costs of $0.11 per kWh). Distribution costs are $100 to $300 per acre-foot.
- Current desalination systems using reverse membrane technology require about 30 percent more energy than existing interbasin supply systems currently delivering water to parts of Southern California.

Desalination Methodology

There are two major types of desalination processes (International Desalination Association, 2000): thermal and membrane. Thermal processes include distillation and compression techniques. Membrane processes include reverse osmosis (RO).

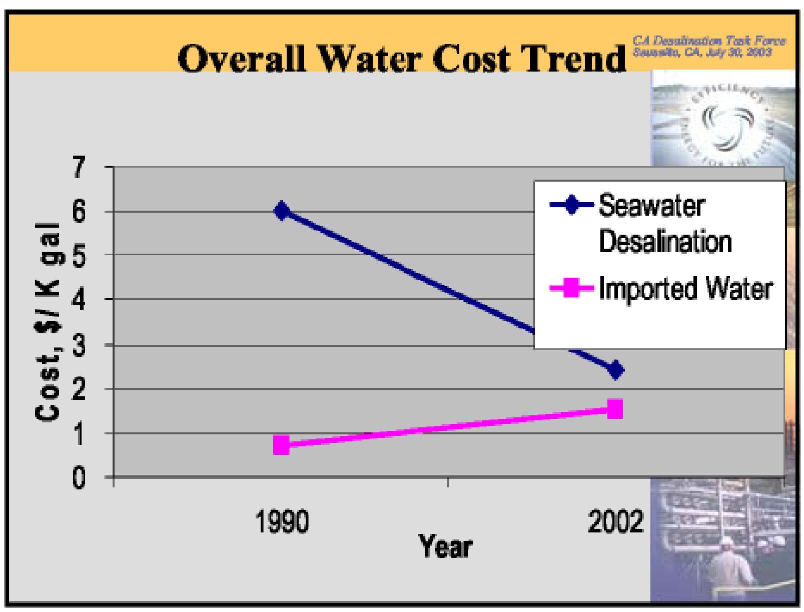
As expected, thermal processes require considerable heat energy, from 158 degrees F up to 230 degrees F, to keep the processes efficient. Membrane technologies, however, mostly require energy for pressurization and do not need high temperatures.

Most desalination plants in the world are older thermal plants (particularly in the Middle East) or RO plants, especially in areas with brackish water (Israel, Tampa Bay, Florida).

Almost all plants planned for Southern California are RO plants with a likely cost range of $130 to $1500 per acre-foot, produced water cost. The latter extreme assumes $0.11 electrical costs per kWh and $300 per acre-foot of distribution cost.

The overall cost of desalination has shown a sharp decline since 1990, while the cost of imported water, including that from the Colorado River, has increased slightly, as shown in Figure 7.

Figure 7. Trend, Water Cost, Desalination versus Imported Water, 1990 to 2002.



Source: *Unit Cost of Desalination* by Shahid Chaudhry, California Energy Commission. 2003.

Bottled Water Process

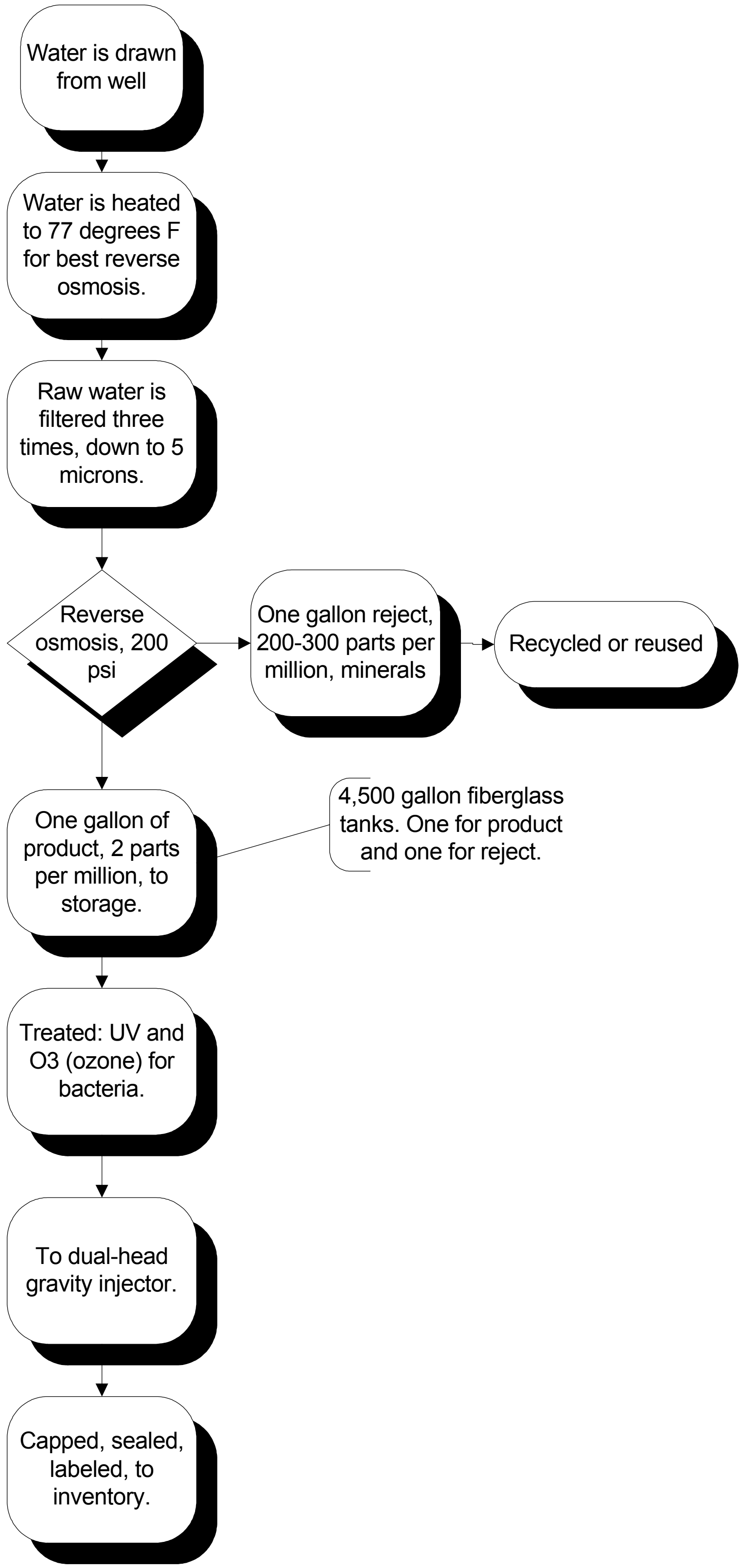
Water bottling is relatively straightforward. First, water is drawn from one of several possible sources; second, depending on raw water characteristics, it may or may not be filtered, purified, or treated (for bacteria); and, third, it is bottled, labeled and distributed to market.

Figure 8 illustrates the bottling process for ABW. The company uses raw well water as its source and then heats it to 77 degrees F for the most efficient RO processing. It is filtered before reaching RO membranes, where water is pressurized to 200 pounds per square inch. Half of the in-feed water is forced through the membrane while the other half (brine, or process reject) is discarded or stored for re-use. Purified water is then treated with ultra-violet light and ozone to kill any bacteria.

ABW bottles its water in 5-gallon re-usable bottles; consumer bottles in the 0.5, 1.0 and 1.5 liter sizes are termed small-package goods or PET (an acronym for polyethylene terephthalate, the resin used to make these bottles). In Alaska, Mat-Maid, Purely Alaska, and Sitka Beverage Corporation manufacture PET bottles using blow mold machines.

Virtually all bottled water export is limited to PET packaged goods. Large containers, such as the 5-gallon bottles that ABW uses, are heavy and not as consumer-friendly as PET bottles.

Figure 8. Alaska's Best Water, Process Flow.



Bottled Water, Market Attributes

Bottled water consumption has grown steadily in the past decade.

Table 8 illustrates 2002 ranking, by country and millions of gallons consumed, for the top ten countries. These ten countries consumed approximately 76 percent of all bottled water in 2002. Compound annual growth rates for each country are shown, along with the worldwide average of 10.3 percent per year, since 1997.

Table 8. Global Bottled Water Market, 1997 – 2002, Quantity and Growth per Year.

2002 Rank	Country	Millions of Gallons				Annual % Growth 1997-2002
		1997	% of World	2002	% of World	
1	United States	3,794.30	17.8	6,018.50	17.3	9.7
2	Mexico	2,767.80	13.0	3,898.60	11.2	7.1
3	China	726	3.4	2,610.10	7.5	29.2
4	Italy	1,995.40	9.4	2,558.20	7.4	5.1
5	Brazil	1,038.00	4.9	2,541.80	7.3	19.6
6	Germany	2,166.70	10.2	2,371.50	6.8	1.8
7	France	1,598.00	7.5	2,225.60	6.4	6.8
8	Indonesia	597	2.8	1,622.50	4.7	22.1
9	Thailand	941.7	4.4	1,277.00	3.7	6.3
10	Spain	935.2	4.4	1,133.70	3.3	3.9
	Top 10 Subtotal	16,560.30	77.8	26,257.40	75.7	9.7
	All Others	4,731.10	22.2	8,435.40	24.3	12.3
	World Total	**21,291.40**	**100.0**	**34,692.80**	**100.0**	**10.3**

Source: Adapted from Beverage Marketing Corporation

Per capita bottled water consumption by the top 15 countries is shown in Table 9. Average worldwide bottled water consumption approximately doubled from 5.7 gallons per person in 1997 to 11.8 gallons in 2002.

Table 9. Global Bottled Water Consumption, Per Capita, Top 15 Countries, Gallons Per Capita. 1997 – 2002.

Rank	Country	1997	2002
1	Italy	35.1	44.2
2	Mexico	28.6	37.7
3	France	27.3	37.1
4	United Arab Emirates	26.8	35.2
5	Belgium-Luxembourg	30.3	32.7
6	Germany	26.4	28.8
7	Spain	23.9	28.2
8	Lebanon	13.8	24.8
9	Switzerland	22.7	24.2
10	Saudi Arabia	17.1	23.8
11	United States	14.1	21.5
12	Cyprus	17.2	21.4
13	Czech Republic	14.2	21.1
14	Austria	18.5	20.9
15	Thailand	15.8	20.1
	Global Average	5.7	11.8

Source: Beverage Marketing Corporation

Table 10 illustrates U.S. bottled water consumption from 1992 to 2002, in gallons per capita, along with annual percent change. For the ten-year period, consumption approximately doubled from 9.8 gallons (1992) to 21.5 gallons (2002).

Table 10. U.S. Bottled Water Consumption, 1992 – 2002, Gallons Per Capita.

Year	Gallons Per Capita	Annual % Change
1992	9.8	—
1993	10.5	7.4
1994	11.5	9.4
1995	12.2	6.4
1996	13.1	7.4
1997	14.1	7.4
1998	15.3	8.3
1999	16.8	10.0
2000	17.8	6.0
2001	19.5	9.6
2002	21.5	10.0

Source: Beverage Marketing Corporation

Figure 9 illustrates the steady growth in U.S. bottled water consumption, on a per capita basis, from 1992 to 2002.

Figure 9. U.S. Bottled Water Consumption, Gallons Per Capita, 1992 to 2002.

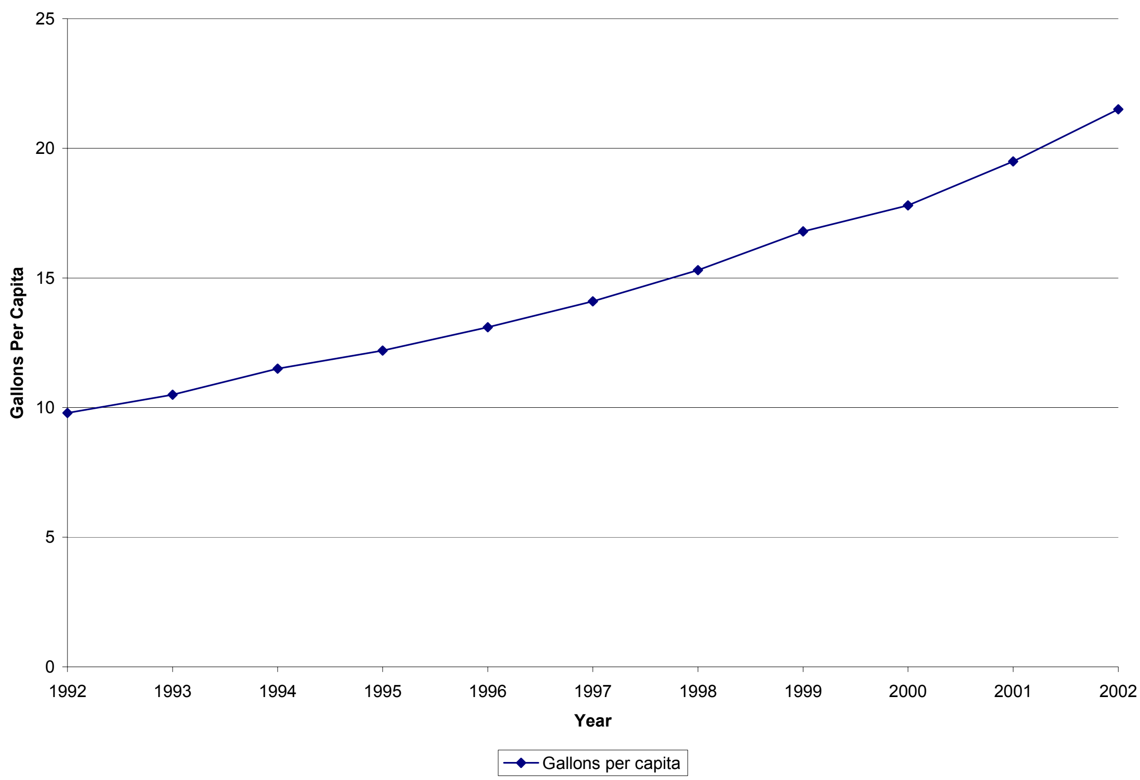


Table 11 illustrates the leading bottled water brands in the U.S., based on wholesale dollar volume, market share, and growth, for the years 2001 and 2002.

Table 11. Leading Bottled Water Brands, U.S., Wholesale Sales, Share and Growth, 2001 – 2002.

Brands	Millions of Dollars		% Share of Sales		% Change 2001/02
	2001	2002	2001	2002	
Aquafina	$645.0	$838.0	9.4	10.8	29.9
Dasani	567.0	765.0	8.2	9.9	34.9
Poland Spring	542.0	621.5	7.9	8.0	14.7
Arrowhead	399.6	456.6	5.8	5.9	14.3
Sparkletts	361.8	321.4	5.3	4.2	-11.2
Deer Park	247.5	311.1	3.6	4.0	25.7
Crystal Geyser	235.0	270.0	3.4	3.5	14.9
Ozarka	183.9	209.6	2.7	2.7	14.0
Zephyrhills	184.4	202.1	2.7	2.6	9.6
Evian	211.2	191.1	3.1	2.5	-9.5
Subtotal	**$3,577.4**	**$4,186.4**	**52.0**	**54.2**	**17.0**
All Others	3,302.6	3,538.6	48.0	45.8	7.1
Total	**$6,880.0**	**$7,725.0**	**100.0**	**100.0**	**12.3**

Source: Beverage Marketing Corporation

According to a bottled water trade publication (Beverage Marketing Corporation), 2002 per capita consumption in the United States was:

- 21.2 gallons of bottled water
- 22.6 gallons of milk
- 22.1 gallons of coffee
- 21.8 gallons of beer
- 54.2 gallons of carbonated soft drinks

Market experts note soft drink consumption has declined in the past four years as other drinks have held steady or, in the case of bottled water, increased at approximately 8 to 10 percent each year.

The two main bottled water companies are Nestle Waters North America (NWNA) and Groupe Danone's Danone Waters of North America (DWNA). NWNA had five brands in the top ten: Poland Spring, Arrowhead, Deer Park, Ozarka, and Zephyrhills. DWNA had two brands in the top ten: Sparkletts and Evian, both of which lost market share.

Both Pepsi-Cola (Aquafina) and Coca-cola (Dasani) were gaining significant market share at the end of 2002. Both firms have concentrated efforts in the PET market segment, a segment that has gained share from a tenth of the market in the early 1990s to a third in 2002.

Bottled Water, Market Summary

Bottled water sales and consumption has shown a steady increase over the past ten years, with annual growth in the 8 to 10 percent per year range. As the market has grown, soft drink bottlers, such as Pepsi and Coca-Cola have entered the market and used their economies of scale to become low-cost producers.

Alaska bottling firms generally confirm these annual growth figures, but face a more limited in-state market. Exporting bottled water, especially as glacial water, is potentially a viable option and one that will become more attractive as shipping volumes increase.

Alaska Bottled Water Companies

Several businesses in Alaska sell water or provide support services for water use. Table 12 shows the known water businesses in Alaska, including primary location, types of products, known markets, and relative sizes.

Anchorage and Fairbanks have a considerable number of water companies, although most Fairbanks businesses provide bulk water and delivery for the local market only. Three of the businesses shown have sold water to markets outside Alaska, primarily to locations on the Pacific Rim.

Table 12. Known Alaskan Water Companies

Company/Product Name	Location	Bottle Sizes/Types	Size of Business	Known Markets
Advanced Water Technologies	Anchorage		Medium	Anchorage
Alaska Glacier Refreshments	Anchorage	PET	Small	Japan, Lower 48
Alaska Polar Glacier Water Co.	Anchorage	PET	Small	Southcentral Alaska
Alaska Pure Water Products	Anchorage	Water Treatment, 5 gal, Water Store	Large	Anchorage
Alaska's Best Water	Anchorage	5 gal	Large	Anchorage, Wasilla, Palmer, Kenai Peninsula
Matanuska Maid Dairy	Anchorage	PET, 1 and 2.5 gal	Large	Alaska, Japan, Lower 48
Winter Frost	Anchorage		Small	
Aqua Alaska	Fairbanks			
Arctic Water Works	Fairbanks	Bulk: Residential Tanks	Small	Fairbanks
Fairbanks Bottled Water Company	Fairbanks	5 gal	Small	Fairbanks
Hydro-Baby	Fairbanks	Bulk Fill Point	Small	Fairbanks
Metro Water Co	Fairbanks	Bulk Deliveries	Small	Fairbanks
Pioneer Wells Water Company	Fairbanks	Bulk Deliveries	Small	Fairbanks
Silver Gulch Brewing Bottling	Fairbanks	Beer, PET?	Small	Fairbanks
Spring Alaska	Fairbanks	5 gal	Small	Fairbanks
Twin Springs Water	Fairbanks	Bulk Deliveries	Small	Fairbanks
Water Wagon	Fairbanks	Bulk and Bulk Fill Point	Small	Fairbanks
Waterman	Fairbanks	Bulk Deliveries	Small	Fairbanks
Alaska Pure Mountain Spring Water	Juneau	5 gal	Small	Juneau
Alaskan Rain	Ketchikan	PET	Small	Ketchikan
Bottled Water Express	Ketchikan	5 gal	Small	Ketchikan
Mount McKinley Clear	Palmer	PET	Small	Alaska
Purely Alaskan Water, Inc.	Palmer	PET	Large	Alaska, Lower 48
Sitka Beverage Corp.	Sitka	PET	Large	Alaska, Asia, Lower 48
Alaska Tok Water	Tok	PET	Small	Tok
Alaska Water Works LLC	Wasilla	Water Treatment	Small	Mat-Su Valley
Choice Alaska Artesian Water	Wasilla	PET	Small	Alaska
Mat-Su Water	Wasilla	Water Treatment, 5 gal, Water Store	Small	Mat-Su Valley

Alaska Bottled Water, Export Shipments

Alaska bottling companies have shipped containers of bottled water from two locations. Sitka Beverage Corporation packaged PET shipments for delivery, via barge and ferry, to the U.S. west coast, including Washington and southern California. The most recent shipment was 29,000 cases purchased by Rite-Aid. Transportation costs have varied but generally average between $0.50 and $1.00 per case. Alaska Glacier has shipped PET bottled water from Anchorage to Japan.

Bottled Water, Container Shipping Costs

Bottled water is generally shipped in a standard 40-foot dry container. Cases are stacked on pallets, in six layers of 12 cases each, for a total of 72 cases per pallet. Each container can hold two rows of nine pallets each, for a total of 18 pallets. The total capacity of a container is 18 x 72 or 1,296 cases. At 24 bottles per case, a container load consists of 31,104 bottles.

Bottlers in Anchorage shipped several containers to southeast Asia via container from the Port of Anchorage. The most recent shipments were sent via Lykes Lines, a new shipper from Alaska.

A shipping quote of $2,200 per container generates transportation costs of $1.70 per case or $0.071 per individual bottle, assuming a standard case size of 24 bottles.

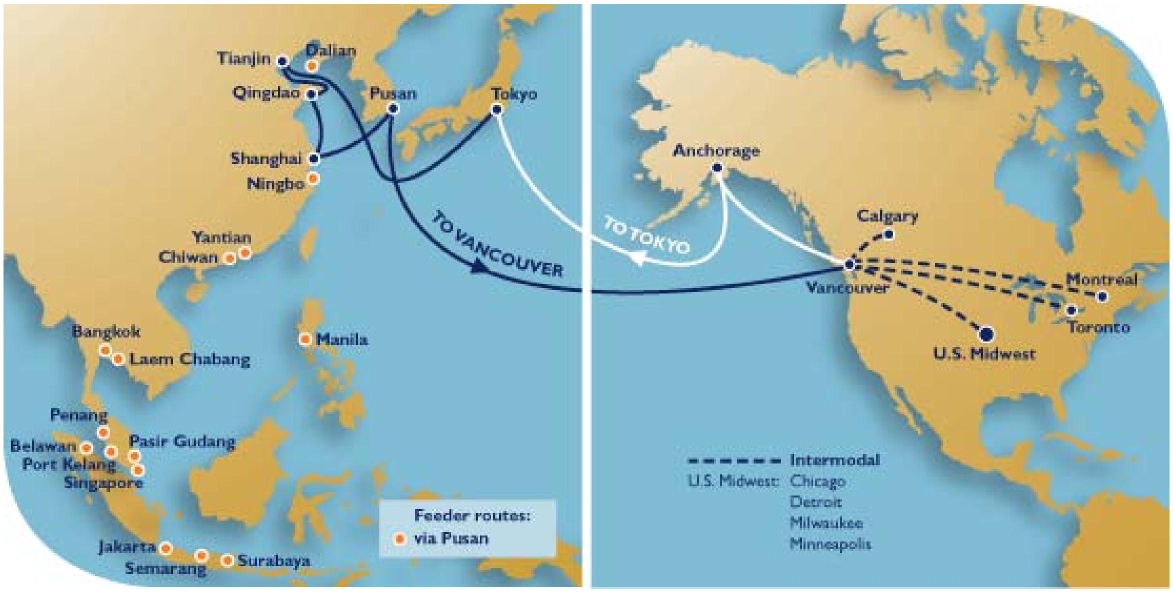
Lykes quotes $2,200 per container for delivery from Anchorage to Japan, direct. Shipping representatives suggest larger volumes shipped on a regular basis could generate lower quotes. One article suggests shippers could enjoy at least a 30 percent reduction in freight costs from Anchorage to Japan[14].

Bottlers in Southeast Alaska ship water to the Seattle area via several methods, including barges, Lynden trucking, and road (from Hyder, for example). Costs are highly variable, depending on volume and method selected, but documents suggest a range of $0.50 to $1.00 per case is a likely range of costs.

This additional transportation cost, from Southeast Alaska to Seattle, is added to container shipping costs from Seattle to Southeast Asia. For this reason, most bottlers in this region are looking to markets in the Pacific Northwest and California.

[14] *New Asia-America ship link may open doors, save money*, Christina Session, Alaska Journal of Commerce, April 14, 2003.

Figure 10. Lykes Lines. Route Map, Anchorage to Tokyo.



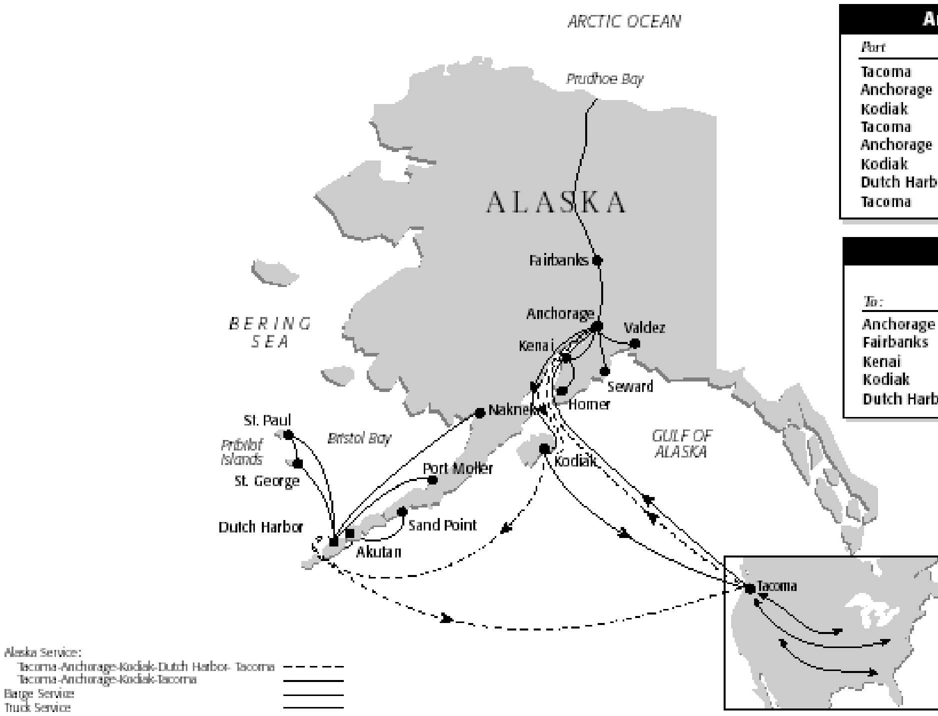
Source: http://66.129.69.16/route.asp, Lykes Lines.

Alternate shipping routes, from Anchorage, include Horizon Lines from Anchorage to Dutch Harbor and then Maersk from Dutch to Japan and other parts of southeast Asia.

Figure 11 illustrates shipping routes for Horizon Lines LLC to Alaska from Tacoma, and also shipping routes within the state.

Figure 12 illustrates shipping routes for Maersk shipping lines, from Dutch Harbor to Yokohama.

Figure 11. Shipping Route, Alaska, Tacoma, Horizon Lines LLC.



Arrivals/Departures

Port	Arrives	Departs
Tacoma		Wednesday
Anchorage	Sunday	Monday
Kodiak	Monday	Tuesday
Tacoma	Friday	Friday
Anchorage	Tuesday	Wednesday
Kodiak	Wednesday	Wednesday
Dutch Harbor	Friday	Saturday
Tacoma	Wednesday	

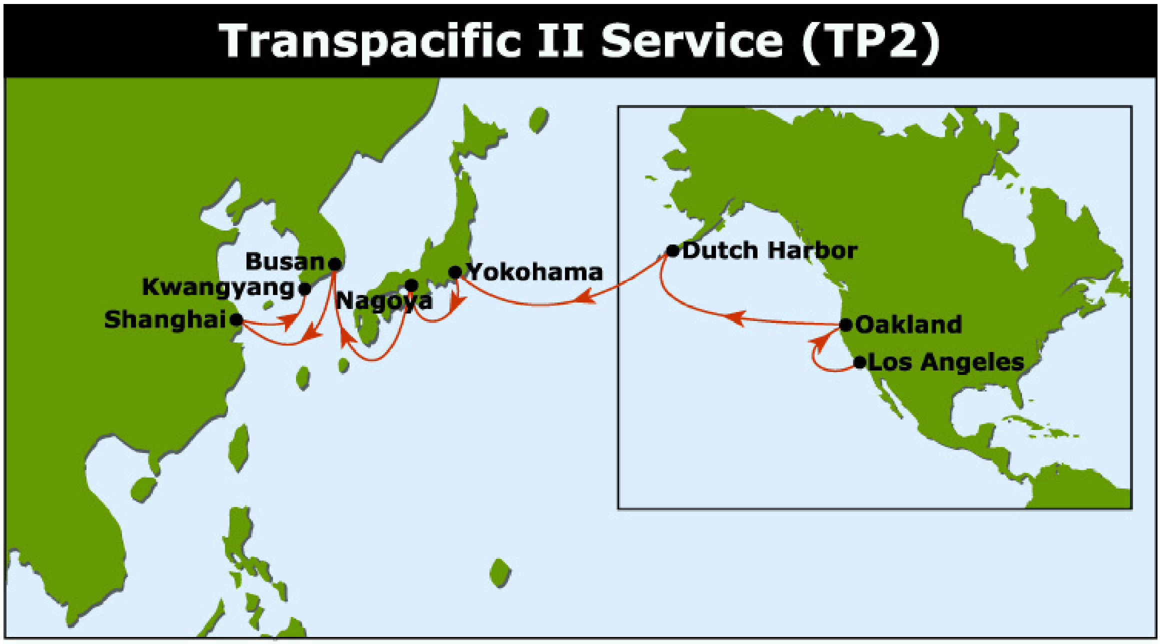
Transit Times

FROM TACOMA

To:	Transit Days
Anchorage	3.5
Fairbanks	4.5
Kenai	4.5
Kodiak	4.5
Dutch Harbor	7.0

Source: Horizon Lines LLC. http://www.horizon-lines.com//alaska.asp. December 24, 2003.

Figure 12. Maersk Shipping Route, Dutch Harbor to Yokohama



Source; http://www.maersksealand-usa.com/advertising/sailing%20schedules/tp2_ib.pdf

Alternatively, containers can be shipped to the Seattle-Tacoma area via TOTE (ocean vessel) or via Lynden trucking (Alaska highway) and then transshipped to southeast Asia.

Regulatory Framework

Raw bulk water has no regulatory oversight. If the end use is drinking water, raw water must be treated to meet drinking water standards.

Bottled water products are all considered food-grade and have the most regulatory oversight, at the federal level. Bottled water is regulated by the federal Food and Drug Administration as a food product, while tap water is regulated by the U.S. Environmental Protection Agency and is regarded as a utility.

Water is classified as "bottled water" or "drinking water" if it meets all applicable federal and state standards, is sealed in a sanitary container and is sold for human consumption[15].

Bottled water cannot contain sweeteners or chemical additives (other than flavors, extracts or essences) and must be calorie-free and sugar-free. Flavors, extracts and essences—derived from spice or fruit—can be added to bottled water, but these additions must comprise less than one percent by weight of the final product.

Beverages containing more than the one-percent-by-weight flavor limit are classified as soft drinks, not bottled water. In addition, bottled water may be sodium-free or contain "very low" amounts of sodium. Some bottled waters contain natural or added carbonation.

This section provides further information about water regulations.

Bottled Water

Bottled water is considered a food product and must meet general requirements for food labeling as contained in 21 CFR 101. This also means nutrient labeling must also be provided if the water contains nutrients or any food component[16].

The Food and Drug Administration's product definitions for bottled water are:

- **Artesian Water or Artesian Well Water:** Bottled water from a well that taps a confined aquifer (a water-bearing underground layer of rock or sand) in which the water level stands at some height above the top of the aquifer.
- **Drinking Water:** Drinking water is water that is sold for human consumption in sanitary containers and contains no added sweeteners or chemical additives (other than flavors, extracts or essences). It must be calorie-free and sugar-free.

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[15] Adapted from references on the International Bottled Water Association, http://www.bottledwater.org, accessed in July 2003.

[16] "What guidance does FDS have for manufacturers of bottled waters?" http://vm.cfsan.fda.gov/`dms/qa-ind4c.html.

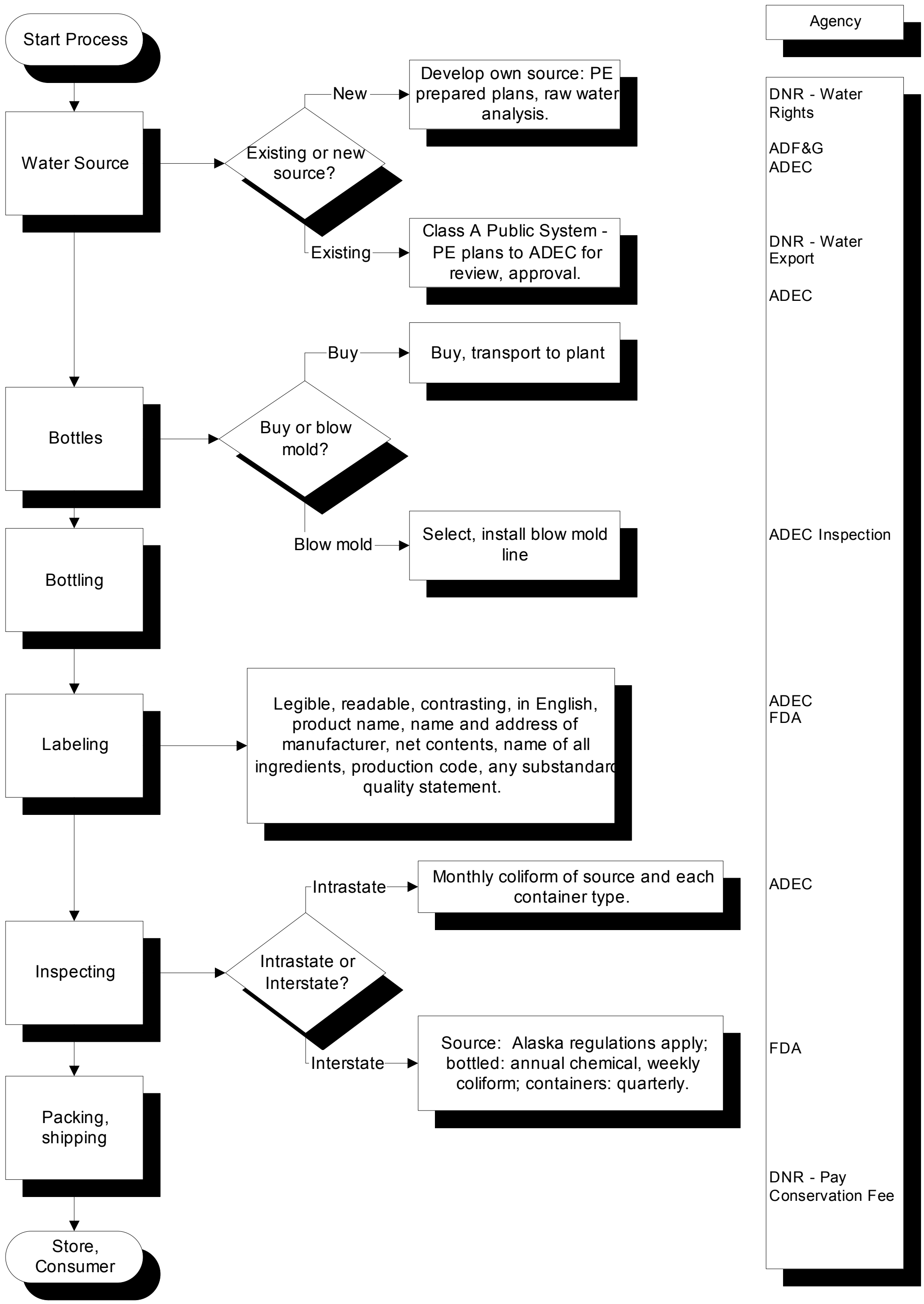
- **Mineral Water:** Bottled water containing not less than 250 parts per million total dissolved solids may be labeled as mineral water.
- **Purified Water:** Water that has been produced by distillation, deionization, reverse osmosis or other suitable processes and that meets the definition of purified water in the United States Pharmacopoeia may be labeled as purified bottled water.
- **Sparkling Water**: Water that after treatment contains the same amount of carbon dioxide that it had at emergence from the source. Soda water, seltzer water and tonic water are not considered bottled waters. They are regulated separately, may contain sugar and calories, and are considered soft drinks.
- **Spring Water:** Bottled water derived from an underground formation from which water flows naturally to the surface of the earth.
- **Well Water:** Bottled water from a hole bored, drilled or otherwise constructed in the ground which taps the water of an aquifer

The Food and Drug Administration has also published Current Good Manufacturing Practice (CGMP) Regulations for processing and bottling drinking water. CGMP regulations apply to all water within sealed containers, packages, etc. and offered for sale for human consumption. Essentially, these regulations require producers to monitor their source water, and to handle all phases of bottling and selling under safe and sanitary conditions.

The U.S. Food and Drug Administration also regulates interstate bottlers (firms that ship water from one state to another) under Title 21, Parts 129 and 165 of the Code of Federal Regulations (21 CFR, 129 & 165). It regulates intrastate bottlers who use containers shipped into Alaska.

Figure 13 illustrates regulatory oversight for Alaska water bottlers.

Figure 13. Alaska Water Bottling, Regulatory Oversight.



Alaska's intrastate regulatory agencies include:

- The Department of Natural Resources, Division of Mining and Water Management: water rights and permitting process, water extraction/appropriation, water export
- The Department of Natural Resources, Office of Habitat Management and Permitting: habitat permitting and protection
- Alaska Department of Fish and Game, Division of Sport Fish: water extraction that impacts fisheries
- Alaska Department of Environmental Conservation, Drinking Water Program: source, treatment and bottled water quality
- Alaska Department of Environmental Conservation, Environmental Sanitation and Food Safety: plant design, operating, microbial testing, labeling, permitting

Glacial Water Resource

Glacial water is a unique feature of Alaska's water supply and has been used as a marketing (branding) characteristic for several bottled water labels. As defined in 18 AAC 31.740, **glacial water** includes:

- Runoff directly from the natural melting of a glacier
- Water obtained from the melting of glacier ice at a permitted food processing establishment
- Stream water that flows directly from a glacier and has not been diluted or influenced by a non-glacial stream

The terms **glacier-blend** and **glacially influenced** mean water from:

- A glacial stream that is influenced by a non-glacial stream
- A lake that is fed by a glacial stream

Bottled water from Alaska that uses any of the above definitions may:

- Be collected and transported by pipes, tunnels, trucks or similar devices
- Not be altered at a food processing establishment; no minerals may be added or removed, but water may be filtered and otherwise treated
- Drawn from a catchment that is connected to the stream or lake water source

Glacial Ice

Firms who wish to export processed glacial ice (not icebergs) also fall under state regulation (18 AAC 31.73) and must obtain a ice-harvest permit or authorization from the DNR.

The processing facility must first be permitted as a food establishment, with weekly sanitizing of food-contact surfaces and daily sanitizing of utensils.

Specific requirements for glacier ice processing include:

- Ice contamination must be minimized during harvest, transportation and storage
- Transport must be done in clean containers or vehicles
- Processing floors must be sloped to floor drains with traps
- Receiving and processing walls must be impervious to water up to at least four feet
- Glacial ice must be cleaned with potable water before processing
- After cleaning, belts, slides or transport equipment that can be cleaned must be used for movement into the processing area
- Manufactured ice must be separated by space or enclosure from any source of contamination
- Glacial and manufactured ice may not exceed drinking water contaminant levels

Public Benefits

Bulk Water Evaluation

As discussed earlier in this report, exports of raw bulk water are not cost-competitive at this time with current desalination technology, although the political process often incorporates other measures and values in the decision making process.

While there may be a unique situation that would result in a long-term raw water export project, the financial analysis section (following) suggests a delivered cost of $9,600 per acre-foot (at Long Beach), or $0.0294 per gallon.

Bottled Water

Bottled water plants are viable businesses in Alaska. In most instances, local Alaskan markets provide base demand and revenues. Exports, if successful, are an incremental increase in production. Bottled water that features glacier water can be a viable export business from an area such as Anchorage, with Eklutna Glacier water and Port of Anchorage container berths.

As other areas develop container berthing facilities and access to glacier water, they will become more likely candidates for bottled water shipments. Dutch Harbor, for example, would be a strong candidate if adequate glacier water was located near its container berths.

There are very large plants operating in the lower 48 states (and in other countries) that produce bottled water on a commodity basis. These plants achieve very low prices due to economies of scale and are generally low-cost producers.

As noted previously, Alaska bottled water producers will have difficulty competing on a price basis with these very large producers. The benefits discussed in this section are for water bottling plants that can achieve a unique marketing proposition and operate in niche export markets, such as bottling and distributing glacier water.

Jobs

Jobs are one of the benefits most cited by proponents of water export facilities. The actual number of jobs can vary significantly depending on the marketing element of the plant's business model.

The three plants with the longest operating history, Alaska's Best Water (1981), Purely Alaska Water (PET bottler) (1993), and Clearly Arctic (PET bottler) (1996) employ 4-6 people in their plants and essentially have a similar business model.

All three have a domestic (local) market, but the PET bottlers export water opportunistically, using the cachet of glacier water and Alaska's image to reach foreign markets. Exports are a relatively small portion of their revenues at this time.

The plants in Hyder, Metlakatla, and Sitka have business models that are fairly similar to each other, based on marketing their products in Southeast Alaska, Canada (particularly for Hyder), and the West Coast states. An exception is the Sitka plant and its trial shipments to Rite-Aid in the Pacific Northwest and its contract with Alaska Airlines for on-board bottled water.

To date, these plants have had difficulty in successfully selling the necessary volume into these markets.

These market targets are much larger than the Southcentral Alaska market that is the primary focus of the three plants in Palmer and Anchorage. As a result, the business concepts for the three Southeast plants projected larger throughput volume and a greater number of employees than the Southcentral plants.

The plant at Sitka reportedly has 17 employees, the Hyder plant was to employ two shifts of 18 and 14 people respectively for a total of 32 but has operated only occasionally as of this date, and the Metlakatla plant could eventually employ two shifts of eight to ten people (16-20 total employment) although in late summer of 2003 the plant had four employees.

Taxes, Royalties, Conservation Fees

All noted bottling plants vary in their contribution to local tax bases. For example, the Matanuska-Maid plant in Palmer (Clearly Arctic), the facility in Metlakatla, and the facility in Hyder are owned by the State of Alaska, the Metlakatla Indian Community, and the Hyder Community Association, respectively. As facilities owned by the public or tribal and governmental entities, they are not subject to state or local taxation and may contribute little in the way of taxation or other government revenues.

Hyder does not have a local government and does not have taxing authority so local taxation is not possible. The entity formed to operate the plants could be subject to State of Alaska corporate income tax. The potential amount of corporate income tax is uncertain but anticipated to be minimal, if any.

The Purely Alaskan Water plant in Palmer is subject to City sales tax, Borough property tax, and State corporate income taxes. The company leases building space but owns plant equipment. This equipment is conservatively estimated at $2 million when new but it is uncertain what the current value of the plant would be with depreciation.

While we are uncertain of the total assessed value of the land, building, and equipment in the plant, if we assume that the total is approximately $2.5 million, then the property taxes paid by the plant (included in rent payments), would be approximately $33,000 per year, given the current tax rate of 13.202 mills in the Borough.

Total sales data are proprietary and the level of sales taxes Purely Alaska Water generates is unknown. While we are uncertain of the corporate structure of the company, most firms in Alaska are incorporated as Subchapter S corporations or Limited Liability Corporations in which profits are passed through to the owners. Under these corporate structures the State of Alaska does not collect any corporate income tax.

Alaska's Best Water is located in Anchorage and would be subject to the Municipality's property tax. The value of the equipment is estimated at approximately $1.2 million and with the land and building may be approximately $1.5 million. This valuation would generate about $26,000 in annual property taxes for the Municipality of Anchorage. Anchorage does not have a sales tax. The corporate structure of the company is unknown and it is uncertain if the State of Alaska would collect any corporate income tax.

The value of the Sitka water plant is unknown but First National Bank of Alaska provided a loan for $5 million to the owners of the company. Assuming a debt to equity ratio of 80:20, the total value of the facility would be about $6 million. This would provide property tax revenues of about $36,000 for the City and Borough of Sitka. Sitka would also receive sales tax revenues from the products that are sold. The corporate structure of the operators of the Sitka plant is unknown so it is uncertain if the plant is subject to the State of Alaska corporate income tax.

Another possible source of income to the state would be an excise tax or royalty on water used in the water plants. The City of Sitka charges 1¢ per gallon of water that is sold and 0.5¢ per gallon for water that is used for cleaning and wash down. Those amounts are likely acceptable for bottling plants but would be too high for bulk, raw water exports since a 1¢ per gallon excise tax or royalty is twice as great as the cost of desalination.

Revenues generated by such excise taxes or royalties on water use in bottling plants would not be significant revenue generators for the state. For example, the two Palmer plants use less than 1,000 gallons per day. At 1¢ per gallon, 1,000 gallons per day would generate only $10 per day. Over the course of a year the state might receive about $2,640, or likely less than $5,000 from both plants. A plant using 29,000 gallons per day, such as proposed at Hyder, might generate more than $76,000 per year but the viability of a plant at this scale has not yet been demonstrated.

Conservation fees of $10 per acre-foot were used for costing purposes in the Financial Analysis section. This figure was derived from DNR estimates in 1994 and amounts to $450 due to the state for each tanker-load of water shipped from Sitka.

In summary, the state is not likely to receive significant revenues from water bottling plants.

If a bulk, raw water facility were to develop in Alaska, it would likely require a very low excise tax or royalty, approximately a few tenths of a cent, to be a viable venture.

Other Community Benefits

In addition to jobs and tax revenues, bottling plants can provide other benefits to rural communities. These benefits include payments for utility services, and some portion of supplies, equipment, repairs, and transportation.

The extent of additional economic activity that would result from a bottling plant is dependent on the degree to which other services, supplies (pallets, for example), equipment, repairs, and transportation (including services such as longshoring and warehousing) can be met with suppliers or vendors located in the community.

In many small, rural Alaska communities a “rule of thumb” is that the multiplier effect of additional spending in the community can range from 10 percent to possibly as high as 30 percent of the original spending level. So for every dollar of sales that the bottling plant makes, the additional economic activity in the community increases by 10 to 30 percent ($1.10 to $1.30). Smaller communities are likely at the lower end of the range while larger communities may be higher.

Financial Analysis

This section presents results of a financial analysis of bulk and bottled water export. A variety of sources were employed to develop the models, which were then tested to determine the sensitivity of results to changes in input values. A break-even analysis was also conducted on the bottled water model to determine the volume of sales required to be profitable.

Capital and operating costs for both bulk water and a bottled water plant of small to medium size are also discussed.

Bulk Water

Capital costs for a bulk water operation, based on the Sitka to Long Beach route (estimated at 2,096 nautical miles), and a 28,000 acre feet per year annual demand, are $270 million. This operation would require 18 single-hulled tankers, each with a capacity of 14.7 million gallons or 45.1 acre feet, and approximately 620 deliveries per year.

Annual operating and minor maintenance costs for this bulk water process are $155.2 million with allowances for administration, engineering, permitting, and contingencies, plus $1.44 million for major maintenance.

Delivered raw water cost, including the $0.01 per gallon royalty to the City of Sitka, is $9,600 per acre-foot. Water treatment costs are projected at $0.003 per gallon, or $1,000 per acre foot.

Total potable water costs, at Long Beach, are $10,600 per acre foot.

Cost Competitiveness, Bulk Water

The California Department of Water Resources estimated high desalination costs (energy cost of $0.11 per kWh) at $1,200 per acre-foot. Adding an additional $300 (high figure) per acre-foot of distribution costs totals $1,500 per acre-foot for processed salt water.

The high end of desalination costs, $1,500 per acre-foot, is approximately 14 percent of the delivered (and treated) water cost of $10,600.

Under the most likely scenario, it is unlikely that export bulk water from Sitka will be cost-competitive in Long Beach.

Bottled Water

A bottled water plant, producing and selling 300,000 cases per year and capable of growing to 400,000 cases annually, could generate $1.5 million in revenue. At this production level, the plant would operate at a projected profit of $62,500 before taxes.

The model was developed to reflect a reasonable market entry point for a new bottled water business. Reaching full plant capacity would require a ramping-up period, estimated at three to five years, and it would depend on plant efficiency, market acceptance of the plant's bottled water, and, most likely, some percentage of export. Export could take the form of water shipped to other North American markets (Canada or the contiguous U.S.)—similar to recent sales from Sitka's bottling plant—and potentially to some Asian markets.

Bulk Water Capital and Operating Costs

The bulk water export analysis utilizes a cost model developed by MWH to determine delivered raw water costs to Long Beach, California from Sitka, Alaska. The model utilizes the quantity of water required and the costs of delivering that water to project the cost per acre-foot in Long Beach.

A copy of the model's printout is included in Appendix C. The model is based on MS Excel and is available from the Denali Commission.

Tanker Capital Costs

For estimating capital costs, the annual volume of raw water to be exported was assumed to be 28,000 acre-feet. Furthermore, the size of the tanker to be used for exporting this water from Blue Lake was assumed to be 350,000 barrels or 45.1 acre-feet. Therefore, eighteen (18) tankers would be needed to export the water.

Other include 20 million gallons of storage at Sitka. The storage tanks would be either large reservoirs on land or reinforced nylon bags in the water at the Sawmill Cove. Tankers would be filled using a gravity fed pipeline from tank storage or pumped from bags.

At Long Beach, raw water would be pumped directly from the tanker into a pipeline, not requiring any storage facilities. Since large tankers are now required to be double hulled for transporting crude oil, there are many used single-hulled tankers available for purchase between $6 and $10 million each. The capital cost estimate assumes $8 million for each tanker.

The total capital cost for single-hulled tankers, port facilities, pipelines and other related appurtenance for exporting 28,000 acre-feet of raw water from Sitka and Long Beach is $270 million. Assuming a 4 percent interest rate over 20 years, the annualized cost of $270 million to the nearest million is $20 million. The estimated capital costs are shown in Table 13.

Table 13. Estimated Capital Costs, Bulk Water Export, 28,000 Acre-Feet Per Year, Sitka to Long Beach.

Cost, Location	Quantity	Unit	Unit Cost ($)	Extended Total ($)
Used Single Hull Tankers	18	Each	8,000,000	144,000,000
Contingency (%)	15			21,600,000
Sitka				
Loading Dock for 2 Tankers	1	Lump Sum	8,200,000	8,200,000
On-Site Storage Tanks or Bags	20,000,000	Gallon	1	20,000,000
Pumping Facilities	1	Lump Sum	-	-
4' Pipeline - Sitka	2,000	Linear Foot	400	800,000
Long Beach				
Loading Dock for 2 Tankers	1	Lump Sum	12,000,000	12,000,000
Pumping Facilities	1	Lump Sum	5,000,000	5,000,000
4' Pipeline - Port to Water System	50,000	Linear Foot	400	20,000,000
			Subtotal:	210,000,000
Administration (%)	5			3,300,000
Engineering (%)	15			9,900,000
Permitting (%)	10			6,600,000
Contingency (%)	25			16,500,000
			Subtotal:	36,300,000
			Total (rounded):	**270,000,000**
Capital Cost, 20 years, 4%			Annual Cost (rounded)	20,000,000

Source: MWH.
Note: Total capital costs rounded up to nearest $10 million; annual costs rounded up to nearest million.

Tanker Operating Costs

The operating cost per tanker per round trip is $250,000. This unit cost includes labor, fuel, fees, overhead, insurance, minor maintenance and repairs, and a rate of return. To meet the 28,000 acre-feet demand, 621 tanker trips would be required. A trip is based on 13 days travel time (2,096 miles at 14 knots) and two days each to load and unload the water. Thus, the annual operating cost would be $155.2 million.

In addition, it was assumed that each tanker would be taken out of service 20 days each year for major maintenance, an annual cost of $1.44 million. These operations and maintenance costs are listed in Table 14.

Table 14. Estimated Operating and Minor Maintenance Costs per Trip, Bulk Water Export, Sitka to Long Beach.

Cost	Quantity	Unit	Unit Cost ($)	Extended Total ($)
Operating Tanker Costs, Per Round Trip				
Load Tanker w/ Raw Water (Sitka)	2	Day	6,500	13,000
Tanker Travel (Payroll)	13	Day	7,500	97,500
Tanker Travel (Fuel)	13	Day	6,000	78,000
Tanker Travel (Other)	13	Day	500	6,500
Unload Tanker (Long Beach)	2	Day	6,500	13,000
Miscellaneous	1	Lump Sum	6,000	6,000
			Subtotal:	214,000
Administration (%)	1.0			2,140
Insurance (%)	0.5			1,070
Routine Maintenance, Repairs, Parts (%)	2.0			4,280
Rate of Return (%)	5.5			11,700
Wharfage Fee	61,248	Ton	0.075	4,600
Conservation Fee to the State of Alaska	45.0	Acre Foot	10.00	450
Contingency (%)	5			10,700
			Subtotal:	35,010
			Total (rounded):	**250,000**

Source: MWH
Note: Total costs rounded up to the nearest $1,000.

The final cost item is raw water cost. Recently, the City of Sitka negotiated $0.01 per gallon price for bulk (raw) water with Quest Imports International. The cost for treating raw water to meet drinking water quality would add another $1,000 to the per acre-foot unit cost.

Table 15 summarizes annual bulk water export costs, delivered to Long Beach from Sitka by tanker, with a purchase price for raw water of $0.01 per gallon.

Table 15. Summary of Annual Costs, Bulk Water Export (28,000 Acre Feet), Sitka to Long Beach.

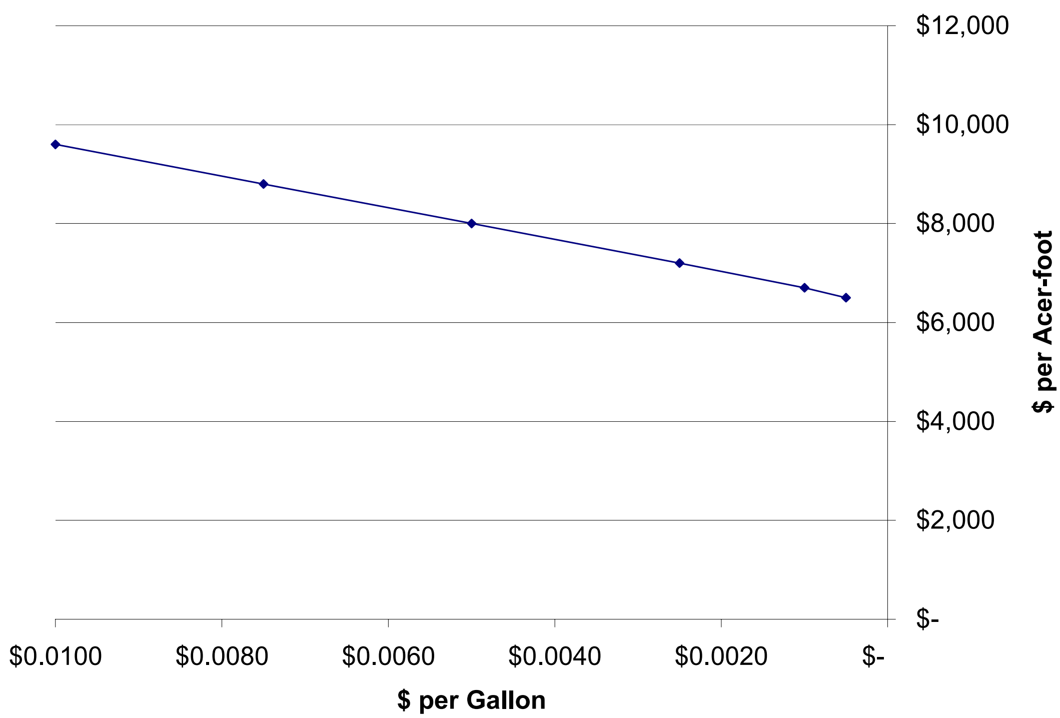
Cost	Quantity	Unit	Unit Cost ($)	Extended Total ($)
Amortized Capital	1	Lump Sum	20,000,000	20,000,000
Raw Water Purchase	621	Round Trip	147,000	91,200,000
Operations	621	Round Trip	250,000	155,200,000
Major Maintenance	18	Tanker	80,000	1,440,000
			Total (rounded):	**268,000,000**
			Cost Per Acre-foot(rounded):	9,600
			Cost Per Thousand Gallons	29.37
			Cost Per Gallon:	$0.0294
Water Treatment Cost, $1,000 per Acre Foot.				10,600
			Treated Cost Per Gallon:	$0.0324

Source: MWH.
Note: Total annual costs rounded up to the nearest million; per acre foot costs rounded up to nearest hundred.

At this raw water price, the cost per acre-foot would be $9,600 or $29.37 per 1000 gallons. Treated water would be $10,600 per acre foot.

Figure 14 shows the acre-foot cost versus the equivalent per gallon price for raw water.

Figure 14. Costs Per Acre Foot, at Selected Per Gallon Costs.



Subsea Pipeline

For a subsea pipeline from Alaska-to-California, the cost per acre-foot for water delivered to Lake Shasta (in Northern California) from Southeast Alaska was estimated in the $4,000 and $5,000 (2003 dollars) range depending on pipeline length (U.S. Congress, 1992).

It appears these are only operational costs and do not include the amortized cost of the $150 billion conceptual cost to build the 2,000-mile pipeline.

Assuming a 14-foot diameter pipe, 4 percent interest, and 50-year life cycle, the amortized cost per acre-foot of the pipeline would be about $1,100 more, making the range $5,100 to $6,100 (2003 dollars).

Bulk Water Transport Evaluation

At this time, the cost of exporting water by tankers is significantly more expensive than desalination.

Also, it appears that a subsea pipeline between Sitka and Lake Shasta is notably cheaper than exporting water by tanker.

Financial Analysis, Bottled Water Export

Projected (pro forma) financial statements for bottled water production and export were prepared using financial information from the Risk Management Association (RMA), current public information for the Sitka Bottling Corporation, and cost data from multiple sources.

Operations described by the spreadsheet model would operate on a single shift, and could produce up to 400,000 cases annually with minimal capital investments. The model was been developed this way to reflect a reasonable market entry point for a new bottled water business.

Assumptions

The bottled water analysis assumes that:

- The business has about $4.2 million in total assets, including $500,000 of bottling and packaging equipment, a 9,000 square foot building for operations and warehousing valued at $1,000,000, and $35,000 in office and delivery equipment.
- Other assets include cash and cash equivalents, inventory, and other assets related to operations.
- Five people are employed to cover all aspects of production, marketing, and administration.

- The business produces 300,000 cases of water annually, at a cost of $2.67 per case, and sells each case for $5.00 wholesale.

Under these assumptions, the business generates revenues of $1.5 million.

Table 16 shows the pro forma income statement for this model operation, along with RMA benchmarks.

Table 16. Bottled Water Pro Forma Income Statement

Revenue and Cost Accounts	Summary Account Dollars	Detailed Account Dollars	% of Revenue Summary Account	RMA Benchmark (%) Summary Account
Revenues	1,500,000		100.0	100.0
Cost of Goods Sold:	991,324		66.1	66.1
Raw Materials Cost (water, bottles)		*801,524*		
Direct Labor Cost (plant labor)		*189,800*		
Gross Profit Margin	508,676		33.9	31.5
Operating Expenses	431,200		28.8	27.0
Selling	112,500		7.5	
General and Administrative:	296,200		19.8	
Indirect Labor Costs (manager)		*96,200*		
Building and Utilities (plant)		*200,000*		
Other Operating Expenses	22,500		1.5	
Operating Profit	77,476		5.2	4.5
All Other Expenses (net)	15,000		1.0	0.9
Net Income (Loss) Before Taxes	62,476		4.2	3.6

Note: RMA benchmarks are for an average national firm with net assets of $2 to $10 million.

The cost of goods sold is approximately two-thirds of total revenue. Operating and other non-operating expenses account for another 27 percent of revenue.

Compared with RMA income statement information for an operation with $4 million in assets, this model would be slightly more profitable than average, with a 4.2 percent profit margin before taxes, versus the national average of 3.6 percent. The gross margin and operating expenses as a percent of sales are consistent with RMA averages.

This conceptual model ignores financial transitions from a start-up company to one that is in full production, a transition that may take up to five years, depending on markets, technology, and management.

This analysis indicates the bottling plant would be profitable under basic assumptions, but it should be noted that the projected rate of return is not commensurate with the expected risk.

As reported on January 22, 2004 on Bloomberg.com, a 30-year U.S. Government Treasury Bond maturing February 15, 2031 currently has a yield of 4.85 percent. This rate could be considered almost a risk free rate and is very similar to that projected for bottling plant operations.

Certainly, the effects of inflation, taxes, ability to raise capital, contribution to economic development, and other business and economic considerations are important in deciding to start a water bottling operation.

However, as alternative investments, the existence of "risk-free" government securities with competitive rates of return will likely deter all but the most dedicated entrepreneur.

Sensitivity Analysis

A sensitivity analysis was conducted on both the bulk water cost model and the bottled water pro forma income statement.

The analysis was conducted using Crystal Ball software, termed an *add-in* for Microsoft Excel. Crystal Ball uses Monte Carlo analysis, allowing users to track output estimates (revenue or price) as input values (costs) fluctuate according to defined probability distributions. Both analyses for this study used 10,000 trials.

Bulk Water Sensitivity

The purpose of the bulk water sensitivity analysis was to determine the likely range of acre-foot cost for water delivered to Long Beach, California from Sitka, Alaska. The analysis allowed variation in the quantity of water demanded, as well as capital and investment costs. All variations were plus or minus 35 percent, except for the cost per gallon paid to the City of Sitka, which was varied from $0.0001 to $0.01 per gallon.

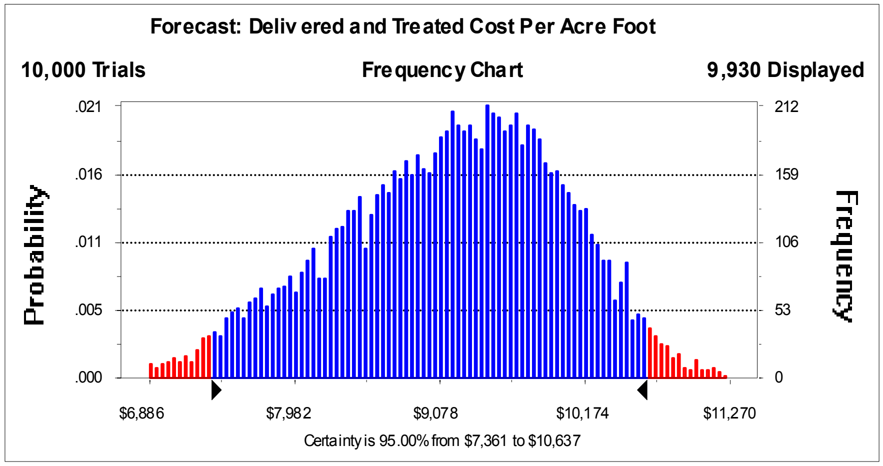
The original cost model rounded the final and many intermediate calculations. For the sensitivity analysis, those restrictions were relaxed to allow a full range of variation in acre-foot costs. As mentioned above, the estimated delivered and treated cost per acre-foot is $10,600.

The sensitivity analysis indicated a delivered and treated cost range of $5,900 to $11,500 per acre-foot. The mean cost was a little under $9,200 and the median was $9,200. The estimated cost per acre-foot discussed above ($9,600) is slightly different from the mean and median costs indicated by the sensitivity analysis due to relaxing the restrictions on various input values and intermediate calculations.

The largest absolute dollar variations in acre-foot cost are caused by the cost of raw water, tanker crew payroll, and tanker fuel costs. The effects of other changes are relatively small.

Figure 15 shows the probability distribution of cost per acre-foot and the range of costs at the 95 percent confidence level.

Figure 15. Probability Distribution of Bulk Water Cost per Acre-Foot



Increasing or decreasing payroll cost by 50 percent only changes delivered water cost by about 11.5 percent. Fuel cost changes of 50 percent generate a 9.2 percent change in acre-foot cost.

These changes suggest elasticities of 0.23 and 0.18 to changes in payroll and fuel costs. The effects of changes in raw water purchase costs are likewise insensitive.

A 50 percent change in raw water costs only causes a 15.8 percent change in the cost per acre-foot. The elasticity of delivered and treated cost to raw water cost is 0.32. Therefore, changes in major factors—raw water costs, fuel costs, payroll costs—do **not** produce significant changes in the relative cost per acre-foot.

This analysis has shown that the cost per acre-foot delivered to Long Beach, California is insensitive to most cost variations. Larger or faster tankers may affect the transportation cost, but for the most part delivered cost per acre-foot cost varies little.

As a result, the success of water export depends on the target market's cost per acre-foot using available transportation, treatment, and competing desalination technology.

Bottled Water Sensitivity Analysis

The purpose of the bottled water sensitivity analysis was to determine the likely profit range (measured before taxes) under an expected range of operating conditions.

The analysis included variations in the input costs (preform bottles, caps, labels, case packing, and water), production levels, and wholesale price per case. Table 17 shows low, likeliest, and high price assumptions for raw materials.

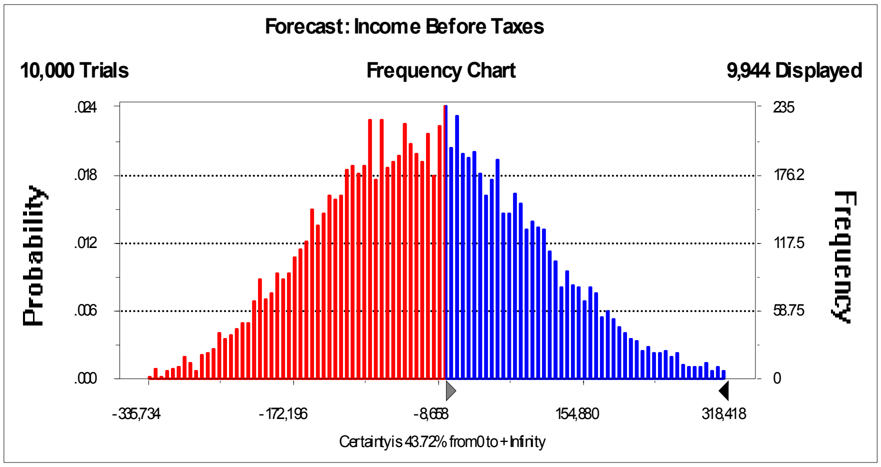
Table 17. Bottled Water Raw Material Price Assumptions

Input	Per Unit Price ($)		
	Low	Likeliest	High
Preform bottles	0.050	0.060	0.100
Caps	0.009	0.010	0.015
Label	0.010	0.015	0.030
Water	0.001	0.010	0.020
Case Packing	0.300	0.600	0.650
Total per Bottle	0.069	0.085	0.145
Total per Case	1.956	2.640	4.130

Annual production levels were allowed to vary from 200,000 to 400,000 cases, with 300,000 being the most likely. Wholesale price per case varied from $4.50 to $5.50, with $5.00 being the most likely.

The sensitivity analysis showed a before-tax range of a loss of $416,000 to a profit of $446,000. The mean loss was $17,000 and the median was a loss of $20,000. Figure 16 shows the probability distribution of profits before taxes.

Figure 16. Probability Distribution of Bottled Water Profit Before Taxes



The analysis shows that the probability of achieving a profit is about 44 percent, as described by the model and its assumptions.

Further refinements to the model and its assumptions would yield a more accurate evaluation. Recommended refinements include adjusting capital costs to fit the range of production capabilities and local prices and determining likely funding and financing options that will affect the new operation's financial burden.

As noted earlier, there are significant variations in costs and revenues when comparing a start-up company with on-going operations. These have to be carefully evaluated for each specific case.

Break-even Analysis

A simple break-even analysis was conducted using the bottled water pro forma income statement. Two analyses were conducted: one for production levels and one for the wholesale price per case.

Using input cost data from a number of sources and an estimated wholesale price of $5 per case, the analysis showed a break-even annual production of 265,827 cases, or just over 22,000 cases per month.

Wholesale price per case has the largest impact on the break-even quantity. If the business were only able to sell cases for $4 wholesale, the break-even quantity would nearly double to 524,000 cases, or nearly 44,000 cases per month.

The second analysis looked at the wholesale price per case needed to break even at specific production levels. With 300,000 cases produced annually, the break-even wholesale price per case is about $4.77. This price drops to $4.32 with a production of 400,000 cases, and increases to $5.67 with a production of 200,000 cases.

Summary, Market Opportunities

Market opportunities for bulk and bottled water operations within Alaska have significantly different profiles. They are discussed in the following subsections.

Alaska Bulk Water Export Potential

Alaska's bulk water, especially from Sitka's Blue Lake, is very clean, with low dissolved solids and is generally free of pesticides, fertilizers, and other industrial and agricultural by-products found in other parts of the world.

The high quality of this raw water makes it very attractive for blending and diluting with other water such as that from southern California.

There is a plentiful supply in most coastal Alaska areas, with Sitka, Anchorage, and Adak representative of several sources.

Cost is the major hurdle to bulk water export. Both capital costs and operating costs are higher than the competing technology, desalination, except in very limited circumstances.

Capital costs for tanker purchases, or pipeline design and construction, are relatively high and unlikely to decline. Operating and maintenance costs for bulk water transport are equally high, whether tanker-based or related to pumping through a pipeline. The long-term trend for these costs is a gradual increase, due to labor and fuel cost increases.

Desalination is the major competitor for Alaska's bulk water and the long-term trend for this technology is a decline in both capital and operating costs. New technologies are being developed as forecasts through 2025 suggest water shortages will continue in most areas, and increase in others.

Alaska Bottled Water Export Potential

Bottled water consumption is growing rapidly throughout the world, with a projected 8 to 10 percent per year rate. Alaska has quality water in considerable supply, including a relatively unique product in the form of glacial water.

Bottling firms are located near tidewater, from Sitka to Anchorage, and they have considerable access to export markets via containerized shipping. Asia has shown strong interest in bottled water (PET) from Alaska, especially with a glacial connection, image, or state certification.

Local markets are more limited and there is strong cost competition from other bottlers, including low-cost producers in the lower 48 states. As bottled water continues to be commoditized, local bottling firms will have to become more cost efficient, which generally means more capital investment (automation). However, it is unlikely local bottling firms can achieve efficiencies of sale enjoyed by large bottling firms such as Pepsi and Coca-cola.

Environmental concerns are low at this time, but future concerns are likely to include solid waste aspects of PET containers.

Appendices

A – References

B – Conversion Factors

C – Bulk (Raw) Water Tanker Export—Sitka, AK to Long Beach, CA

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Appendix B—Conversion Table

Unit	Metric		English	Unit
Cubic Meters	1,000,000	==>	810.7	Acre Feet
Cubic Meters	1,000,000	==>	264,200,000	Gallons
Cubic Meters	1,000	==>	264,200	Gallons
Cubic Meters	1	==>	264.2	Gallons
Cubic Meters	1,233	<==	1	Acre Foot
Acre Foot	1	==>	325,900	Gallons
Cubic Meters	3.785	<==	1,000	Gallons
Cubic Meters	3,785	<==	1,000,000	Gallons
Liters	3,785,000	<==	1,000,000	Gallons
Acre foot	3.07	<==	1,000,000	Gallons
Cubic Meters	3,785,000	<==	1,000,000,000	Gallons
Liters	3,785,000,000	<==	1,000,000,000	Gallons
Liters	1,000,000	==>	264,200	Gallons
Liters	1,000	==>	264.2	Gallons
Liters	1,000	==>	1	Cubic Meters
Cubic Meters	28.32	<==	1,000	Cu Ft
$/Acre-foot=>	**$/1000 gallons =>**		**$/cubic meter**	
$ 400	$ 1.23		$ 0.32	
$ 600	$ 1.84		$ 0.49	
$ 800	$ 2.45		$ 0.65	
$ 850	$ 2.61		$ 0.69	
$ 860	$ 2.64		$ 0.70	
$ 900	$ 2.76		$ 0.73	
$ 1,000	$ 3.07		$ 0.81	
$ 1,200	$ 3.68		$ 0.97	
$ 1,600	$ 4.91		$ 1.30	
$ 2,000	$ 6.14		$ 1.62	
$ 2,400	$ 7.36		$ 1.95	
$ 2,800	$ 8.59		$ 2.27	
$ 3,200	$ 9.82		$ 2.60	
$ 3,600	$ 11.05		$ 2.92	
$ 4,000	$ 12.27		$ 3.24	
$0.00/Gallon =>	**$/1000 Gallons =>**		**$/Acre-foot=>**	**$/cubic meter**
$ 0.001	$ 1.00		$ 326	$ 0.26
$ 0.002	$ 2.00		$ 652	$ 0.53
$ 0.003	$ 3.00		$ 978	$ 0.79
$ 0.004	$ 4.00		$ 1,304	$ 1.06
$ 0.005	$ 5.00		$ 1,630	$ 1.32
$ 0.006	$ 6.00		$ 1,955	$ 1.59
$ 0.007	$ 7.00		$ 2,281	$ 1.85
$ 0.008	$ 8.00		$ 2,607	$ 2.11
$ 0.009	$ 9.00		$ 2,933	$ 2.38
$ 0.010	$ 10.00		$ 3,259	$ 2.64

Appendix C—Bulk (Raw) Water Tanker Export—Sitka, AK to Long Beach, CA

Bulk Raw Water Export By Tanker - Sitka, AK to Long Beach, CA

Basis of Estimate (Control Board):

1	**Raw Water Supply Per Year**	**28,000**	**Acre Foot**	**=**		**9,123,828,000**	**Gallon**	
2	**Tanker Size**	**350,000**	**Barrel**	**=**	**45.1**	**Acre Foot**	**=**	**14,700,000 Gallon**
3	**Distance Between Ports**	**2096**	**Nautical Miles**					
4	**Average Speed of Tanker**	**14**	**Knots**					
5	**Travel Time**	**150**	**Hours**	**=**	**6.3**	**Days**		
6	**Tanker Deliveries Per Year**	**621**						
7	**Number of Tanker Deliveries Per Day**	**1.7**						
8	**Time Between Deliveries Per Tanker**	**16**	**Days**					
9	**Tankers Needed to Meet Supply**	**18**						
10	**Deliveries Per Tanker Per Year**	**34.5**						
11	**Days Out of Service for Annual Maintenance**	**20.2**	**Per Tanker**					
12	**Storage Capacity**	**20,000,000**	**Gallon**					
13	**Cost of Raw Water**	**$ 0.0100**	**Gallon**					

Note: Capital costs for port improvements are estimated for handling and loading 2 tankers only. Except for the capital cost of tankers, the control board does not revised the capital costs for additional port facilities for larger tankers and/or more tanker slips.

Capital (Investment) Cost

	Quantity	Unit of Measure	Unit Cost	Extended Total
Used Single Hull Tankers w/ Ballast Tanks and Pumps	18	Each	$ 8,000,000	$ 144,000,000
Contingency	15%			$ 21,600,000
			Subtotal:	$ 165,600,000
Sitka				
Loading Dock for 2 Tankers & Related Apputenances	1	Lump Sum	$ 8,200,000	$ 8,200,000
On-Site Storage Tanks or Off-Shore Storage Bags	20,000,000	Gallon	$ 1	$ 20,000,000
Pumping Facilities (Auumed Tankers Will Be Gravity Feed)	1	Lump Sum	$ -	$ -
4' Pipeline - Existing Aqueduct to Dock Site	2,000	Linear Foot	$ 400	$ 800,000
Long Beach				
Loading Dock for 2 Tankers & Related Apputenances	1	Lump Sum	$ 12,000,000	$ 12,000,000
Pumping Facilities and Related Apputenances	1	Lump Sum	$ 5,000,000	$ 5,000,000
4' Pipeline - Port of Long Beach to Region's Imported Water System	50,000	Linear Foot	$ 400	$ 20,000,000
			Subtotal:	$ 66,000,000
Administration	5%			$ 3,300,000
Engineering	15%			$ 9,900,000
Permitting	10%			$ 6,600,000
Contingency	25%			$ 16,500,000
			Subtotal:	$ 36,300,000
			Total:	**$ 270,000,000**

Rounded Up to the Nearest 10 Million

MWH

Annualized Capital Cost at 4% over 20 years: $20,000,000

Rounded Up to the Nearest Million

Cost of Raw Water Per Tanker Per Round Trip

Blue Lake (Sitka)	14,700,000	Gallon	$	0.0100	**$**	**147,000**

Operating Costs Per Tanker Per Round Trip

Load Tanker w/ Raw Water (Sitka)	2	Day	$	6,500	$	13,000
Tanker Travel (Payroll)	13	Day	$	7,500	$	97,500
Tanker Travel (Fuel)	13	Day	$	6,000	$	78,000
Tanker Travel (Other)	13	Day	$	500	$	6,500
Unload Tanker (Long Beach)	2	Day	$	6,500	$	13,000
Miscellaneous	1	Lump Sum	$	6,000	$	6,000
Note: Assumes 6.5 day travel time each way between ports.				Subtotal:	$	214,000
Administration		1.0%			$	2,140
Insurance		0.5%			$	1,070
Routine Maintenance / Minor Repairs and Replacements		2.0%			$	4,280
Rate of Return		5.5%			$	11,770
Wharfage Fee	61,248	Ton	$	0.075	$	4,600
Conservation Fee to the State of Alaska	45.0	Acre Foot	$	10	$	450
Contingency		5%			$	10,700
				Subtotal:	$	35,010
				Total:	**$**	**250,000**
						Rounded Up to the Nearest Thousand

Major Maintenance Per Tanker Per Year

Out of Service Maintenance (1% of the Initial Purchase Value)	1%	Each	$	8,000,000	**$**	**80,000**

Annual Cost Summary (Including Amortized Capital Cost)

Amortized Capital	1	Lump Sum		$20,000,000	$	20,000,000	7.5%
Raw Water Purchase	621	Round Trip	$	147,000	$	91,200,000	34.1%
Operations	621	Round Trip	$	250,000	$	155,200,000	57.9%
Major Maintenance	18	Tanker	$	80,000	$	1,440,000	0.5%
				Total:	**$**	**268,000,000**	100.0%
						Rounded Up to the Nearest Million	
				Cost Per Acre Foot	**$**	**9,600**	
						Rounded Up to the Nearest Hundred	
				Cost Per 1000 Gallon	**$**	**29.37**	
				Cost Per Gallon	**$**	**0.0294**	

Add On - Annual Water Treatment Cost

Potable Water Treatment Cost by User	9,123,828,000	Gallon		$0.0030	$	27,400,000
						Rounded Up to the Nearest One Hundred Thousand
				Cost Per Acre Foot	**$**	**1,000**
						Rounded Up to the Nearest Hundred